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FIELD EVALUATION OF EXPERIMENTAL DELINEATION

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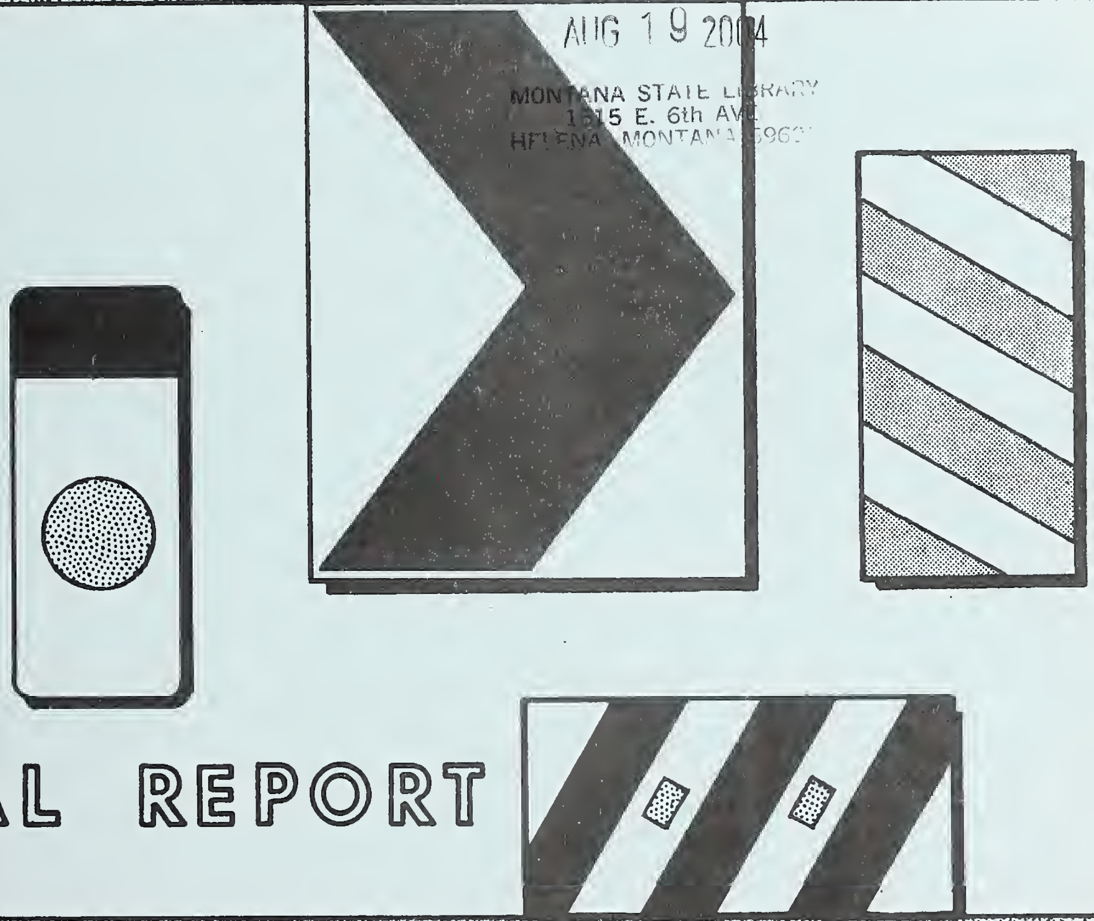

FINAL REPORT

PREPARED BY

Montana Department Of Highways
Planning And Research Bureau
Contract No. DOT-FH-11-8611

APRIL 1979

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FIELD EVALUATION
OF
EXPERIMENTAL DELINEATION

Planning & Research Bureau
MONTANA DEPARTMENT OF HIGHWAYS
2701 Prospect Avenue
Helena, Montana 59601

APRIL 1979

FINAL REPORT

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FOREWARD

The work reported herein was conducted in accordance with Basic Agreement DOT-FH-11-8611, Task Order Number Three, and in conformity with the DOT reporting requirements, DOT-TST-75-97. The research reported herein was conducted during the time period of February 1978 through April 1979. This document covers the research, field test work and conclusions reached in relation to experimental roadway delineators.

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SUMMARY

Highway post mounted delineators, in addition to edge and center stripes and other signs, are used to provide the motorist with information about the roadway ahead, such as width, grade and alignment. Under conditions of darkness or other periods of reduced visibility, the use of reflectorized delineators leads to increased travel speed and driver awareness.

Traditionally, the most common post-mounted delineators have been either 4" x 4" squares, 4" x 6" rectangles, or 3" circular delineators, with limited use of larger signs. Relatively few in-depth studies have been conducted to evaluate the effectiveness of the various forms and most of these have dealt with limited aspects of specific delineation treatments. The use of post-mounted delineators as part of an overall system for roadway delineation has received little attention.

For certain types of roadway conditions, standard delineation treatments have not been effective in preventing run-off-the-road accidents. Consequently it has been felt that variations in size, shape, design and spacing could lead to a significant reduction of this type of accident. To test this hypothesis, this organization developed a program to install and evaluate a number of non-standard post-mounted delineators which have not previously been analyzed through objective analytical procedures.

The scope of this project was limited to the design, installation, and evaluation of four types of post-mounted delineators on twenty selected sections of highway. These twenty installations were evaluated for their relative effectiveness in reducing total accidents, night accidents, and total run-off-the-road accidents, with special emphasis on nighttime, run-off-the-road accidents. The installation of the delineators resulted in a 32.9% reduction of the night-time run-off-the-road accidents for the entire project, which was statistically significant at the 80% level of confidence.

The limited findings of this report suggest that improved delineation of specific areas of highways in general could lead to an overall reduced level of accidents and to marked reductions of specific types of accidents. The study findings also suggest that well delineated highways are more asthetically pleasing, and pleasant to drive upon, especially at night.

DISCUSSION

In February of 1978, the Planning and Research Bureau of the Montana Department of Highways entered into a contract with the Federal Highway Administration to investigate experimental post-mounted delineation. The contract specified the selection of four delineator configurations and five study evaluation sections for each configuration, for a total of twenty study evaluation sections.

In the selection of delineator configuration a variety of sizes, colors, shapes and designs were considered. A closely related factor which was considered and analyzed was the side-of-road spacing of the delineators.

All delineators were installed according to the Montana Department of Highways standard specification as to mounting height, placement in regard to shoulder lines, slopes and degree of the highway curves involved. Typical details for the post mounted delineators are located on pages 21, 22, 23 and 24 of the Appendix. Straight line diagrams exhibiting installation locations follow the appropriate typical sketch. Photographs depicting at least one roadway section of each configuration of delineator are included in the appendix.

TYPE I

Type I of the post mounted delineators was designed for use on flat, shallow curves and adjoining tangent sections of roadway. A delineator design of intermediate size (6" x 12" - larger than current standards but smaller than the others in this study) was desired because of the longer lengths of roadway generally accompanying this type of highway design. The design incorporated a 4" black dot superimposed on a silver high intensity reflectorized surface. With a smaller configuration, the cost of future projects using this style of delineator could be minimized.

TYPE II

A large variety of highway alignments were used as study sections for Type II post mounted delineators. These ranged from a straight roadway

containing a bridge to several sharp curves. This style of delineator measures 12" x 36" and consists of alternating high intensity reflectorized yellow and black diagonal stripes.

TYPE III

Type III post mounted delineators were used on curved and serpentine segments of roadway. The design of this delineator is a variation of the standard X1-1 'Object Marker' (12" x 36" - high intensity reflectorized silver and black diagonal stripped). In our variation, two 4" x 4" silver rhombus' are superimposed over two black stripes of the standard sign as shown on the typical detail, page 23. The addition of the two reflectorized 'silver rhombus' is felt to yield a more dramatic sign.

TYPE IV

The Type IV was used exclusively on single curves or on multiple 'S' type curves. The newly introduced W1-8 Chevron Alignment Sign (a 24" x 30" high intensity reflectorized yellow sign with a black arrow) was chosen to test the effectiveness of the new design.

In the selection of the twenty highway sections involved in the review, an existing computer 'accident cluster area' program was utilized. The program searched the State maintained Primary and Secondary Highway systems and identified sections of roadway, one mile in length, where eight or more nighttime run-off-the-roadway accidents had occurred over a five year period. Areas where reconstruction would occur within the next five years were omitted to permit continued uninterrupted surveillance of the delineator performance.

The accident records for the one-mile segments were then examined to identify specific problem areas or locations, which often condensed the section of roadway for which delineators were required. This reduced the mileage involved and afforded greater accuracy in the evaluation. Department personnel conducted a field survey of these shorter highway sections and defined the delineator post locations at the same time. Posts and delineators were later installed by Department of Highways maintenance forces.

EVALUATION

The Before and After Study method was used to evaluate the effectiveness of the project. This procedure calls for the collection of pertinent data for a specific period before and after the improvement is made. The optimum time frame for data analysis would be for equal before and after time periods of at least three years.

In order to make the statistical tests as significant as possible, all available accident and traffic data was utilized. The accident data for the 'before' period ranged from 41 months to 69 months with an average of 63.7 months. As specified in the study contract, the project completion data was set for June 30, 1979 with a possible two year extension. Therefore, the 'after' analysis period ranges from 4 to 37 months with the median falling at 6 months. The study staff felt the 'after' period should have been longer, but was limited in this regard by a provision in its contract with the FHWA.

Rate-related calculations were chosen since annual ADT values are available and the rate formula used tends to equalize the dissimilarities of the before and after time periods. Analysis was performed for four catagories of accidents including a) run-off-the-roadway, b) nighttime, c) nighttime run-off-the-roadway and d) total. For these four groups of accident data, calculations were made to obtain the numbers of accidents and accident rates for each study area.

The accident rate formula is:

$$\text{Accident Rate} = \frac{\text{Total Numbers of Accidents} \times 1{,}000{,}000}{(\text{ADT}) \times (\text{Length of Roadway}) \times (\text{No. of Months}) \times 12}$$

The values derived from the above equation are presented in Tables II, III and IV.

All highway evaluation sections were first analyzed individually, then were combined by each type of delineator, and finally were combined for the project as an entirety.

Calculation of the percent change in accident rate, as presented in Table VI, was based upon the historic expected rate of increase in accidents. These percent changes are employed in the Poisson Test of Statistical Significance. The formula used to determine these values is:

$$\text{Percent Change of Rate} = \frac{Bi - Ai}{B_i} \times 100$$

where Ai = After accident rate
Bi = Before accident rate

The 80% level of confidence for the Poisson Test was used, based on the consideration that this was a relatively low cost program. The significance test was performed on each of the four accident groups, for each type of delineator.

An economic justification analysis, using the Benefit-Cost Method was conducted on the night time run off the road where the categoric reduction was most significant. The estimated service life of the project was 10 years with the assumption of a negligible salvage value. The assumed interest rate was 8%. The annual cost for the overall project maintenance was estimated at $2,000.00. Costs for preliminary investigations and initial installations were $23,117.68.

The accident cost figures used in the economic analysis were those established by the National Safety Council (1977) of $125,000 for each fatality, $4,700 for each injury (independent of severity), and $670 for each property damage accident.

The desired units of effectiveness revolve around accident reduction. Therefore, the number of fatal, injury and property damage accidents that were reduced annually are used in the calculation of annual benefits rather than the number of fatalities or personal injuries.

The capital recovery factor was calculated using the following equation:

$$CR_n^i = \frac{i(1 + i)^n}{(1 + i)^n - 1}$$

where, i= assumed interest rate

n= the service life of the project

$$CR_n^i = \frac{.08\ (1.08)^{10}}{(1.08)^{10}-1}$$

$$= 0.149$$

The Equivalent Uniform Annual Benefits (EUAB) was calculated using the following equation:

$$EUAB = CR_n^i \sum_1^m (B_m\ PW_m^i)$$

where:

m = number of years of after data

B_m = benefit for 'm' year

PW_m^i = Present worth factor for 'm' year at a interest rate i.

$$= \frac{1}{(1 + \underset{i}{\cancel{1}})^m}$$

$$PW_1^1 = \frac{1}{(1.08)^{.5}} = 0.962$$

B_m = 125,000 (Af) + 4700 (Ai) + 670 (Apd)

where: Af= annual fatal accidents reduced = 0.12

Ai= annual injury accidents reduced = 4.51

Apd= annual property damage accidents reduced= 3.95

Bm = 38,843.50

$$EUAB = (0.149)\ (38{,}843.5)\ (0.962)$$

$$= 5567.75$$

The Equivalent Uniform Annual Cost (EUAC) was calculated using the following equation.

$$EUAC = (I)\ (CR_n^i) + -(T)(SF_n^i)$$

where:

I = initial cost of the project
i = assumed interest rate
n = service life of the project
T = terminal value
K = annual cost for maintenance

$$\begin{aligned} EUAC &= (23,117.68)\ (0.149) + (2,000)(0) \\ &= 5444.53 \end{aligned}$$

The Benefit Cost ratio was calculated using the following equation:

$$\frac{B}{C} = \frac{EUAB}{EUAC} = \frac{5567.75}{5444.53} = 1.02$$

The benefits of this project outweigh the costs incurred.

CONCLUSIONS

FIELD INVESTIGATION

From the nighttime field investigation of all study areas in August of 1978, it was the visual observation of study personnel that:

1. Installation of the Type I delineator (6" x 12" silver with a black dot) on variable spacing intervals, not in conformance with the standard fixed length interval, was necessary in order to be visually effective.
2. The installation of the Type II and Type III delineators (12" x 36" diagonally striped) on variable spacing intervals was visually effective.
3. It was the opinion of the study staff that the visual effect of the Type IV (Chevron) would be enhanced if the signs were installed at closer intervals.
4. The high intensity reflector material used on all of the delineators was clearly more visible than standard materials.

ACCIDENT HISTORIES

A comparison of the accident histories for the 64 month before period and the relatively short 8 month after period, for each type of delineator as grouped was performed in April of 1979. The majority of the areas show a reduction in the nighttime run-off-the-road accident rates. It was also shown that these delineators had a positive effect in reducing all accidents, including those which occurred in the daylight hours. Table IV shows the before and after accident rates along with the percentage change.

It is the opinion of the evaluators that the average six to eight month period of 'after' accident data was not sufficiently long to effectively and accurately evaluate the areas involved. It would be desirable to have equivalent before and after time periods for accident data with a minimum of 3 years for each time period. Therefore an extension of the time period for the project is recommended.

Results of the accident studies for the various delineator-study sections are as follows:

I. Although evaluation of all the Type I delineator study areas indicated an overall increase in the nighttime run-off-the-road accident rate of 13%, there was a decrease of 19% in the overall total run-off-the-road accident rate. Two of the areas involved in this group experienced no run-off-the-road accidents. This type of delineator appears to be particularly effective on tangent, straight sections of roadway.

II. The Type II delineator showed the greatest overall reduction of accidents with a complete elimination of run-off-the-road accidents in all five study areas. There was also a significant reduction in the total accident rate. The performance of this delineator was clearly better than the other three tested.

III. There was a statistically significant reduction in the nighttime run-off-the-road accident rate for Type III delineators. One of the study areas in this group (Coram-Hungry Horse) showed an increase for both total and daytime run-off-the-road accident rates. When this one study area is removed from the total group, significant reductions of the accident rates for the remaining four study areas was noted (shown in Table V). There was no obvious reason or explanation why the Coram-Hungry Horse study section ran counter to the trend of this group. Further investigation of the area will be conducted.

IV. The Chevron-Type IV delineator indicated significant reductions in the total nighttime, nighttime run-off-the-road, and total run-off-the-road accident rates. Reductions of 51.5%, 52.0%, and 21.2%, respectively, were noted, all of which were statistically significant.

In the opinion of the evaluator, using all available data, the study objectives were clearly fulfilled by the type II, III and IV post mounted installations. This is evidenced by the nighttime run-off-the-road accident rate reductions of 100%, 17.0%, 52% and 33% for delineator Types II, III, IV and ALL types respectively. All were statistically significant at the 80% level of confidence. Furthermore a benefit-cost ratio of 1.02 was achieved. This ratio was calcu-

lated based upon the reduction of nighttime run-off-the-road accidents since this was the objective of the program. The Type I delineator was of marginal value in accomplishing the study objective.

The results of this evaluation indicate that the experimental project was successful in reducing nighttime run-off-the-road accidents.

TABLES

TABLE I

ROUTE	LOCATION - DESCRIPTION	MILEPOST		BEFORE DATE FROM 1-1-73		# MONTHS AFTER	ADT BEFORE	ADT AFTER	LENGTH IN MILES
		FROM	TO	TO	# MONTHS				
P-7	Near Missoula	89.6	90.2	8-4-78	67	5	5924	7133	0.4
P-5	Evaro Hill	2.97	5.0	8-4-78	67	5	3786	4131	2.03
P-1	Kalispell	139.0	139.7	6-19-78	66	6	4206	4204	0.7
P-1	Near Cut Bank	253.8	254.44	6-14-78	65	7	2131	2476	0.44
P-28	Near Red Lodge	70.28	71.0	6-13-78	65	7	1184	928	0.72
P-7	Near Missoula	88.6	89.3	8-4-78	67	5	5924	7028	0.7
P-5	South of Arlee	16.8	17.7	7-28-78	67	5	3382	3575	0.9
P-5	Curve Near Ravalli	24.7	25.7	7-27-78	67	5	3484	4938	1.0
P-8	West of Townsend	75.8	76.4	6-19-78	66	6	1892	2572	0.6
P-1	Near Havre	384.4	385.5	7-18-78	67	5	2988	8139	1.1
P-24	Rainbow Bend	8.5	9.0	10-9-75*	46	38	1737	2156	0.5
P-5	Near Polson	56.4	57.2	6-1-78	65	7	4207	5450	0.8
P-50	Near Big Sky	50.4	52.1	7-7-78	66	6	1370	1313	1.7
P-14	Deep Creek Canyon	8.3	9.1	6-21-78	66	6	402	576	0.8
P-1	Corum-Hungry Horse	142.3	143.9	5-15-76	41	31	2761	3323	1.6
P-7	Near Missoula	85.2	87.6	7-28-78	67	5	5924	7028	2.4
P-6	Plains to Paradise	77.6	78.5	7-27-78	67	5	1125	1481	0.9
S-205	Bozeman-Belgrade	22.0	23.0	5-30-78	65	7	2415	3170	1.0
P-82	Big Fork-Somers	4.7	5.5	5-26-78	65	7	2161	2385	0.8
P-1	Columbia Heights-E.	141.9	142.3	5-26-78	65	7	2411	3773	0.4
SUB-TOTALS BY TYPE OF DELINEATOR									
	TYPE I				66	6	3446.2	3774.4	4.29
	TYPE II				66.8	5.1	3534.0	5250.4	4.3
	TYPE III				56.8	17.6	2095.4	2563.6	5.4
	TYPE IV				65.8	6.2	2807.2	2933.4	5.5
TOTAL ALL AREAS					63.9	8.7	2970.7	3630.5	19.49

*Before Period from 1-1-72

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TABLE II - ‘BEFORE’ ACCIDENT DATA

		NIGHT TIME RUN-OFF THE-ROADWAY				RUN-OFF-THE-ROADWAY				ALL NIGHT-TIME				ALL ACCIDENTS			
ROUTE	LOCATION-DESCRIPTION	TOTAL	FATAL	INJ.	P.D.	TOTAL	FATAL	INJ.	P.D.	TOTAL	FATAL	INJ.	P.D.	TOTAL	FATAL	INJ.	P.D.
P-7	Near Missoula	11	1	3	7	15	1	5	9	17	1	6	10	28	1	12	15
P-5	Evaro Hill	21	1	11	9	32	1	13	18	30	1	13	16	59	4	22	33
P-1	Kalispell	7	0	4	3	10	1	5	4	10	0	6	4	21	1	9	11
P-1	Near Cut Bank	12	0	10	2	14	0	12	2	14	0	12	2	22	0	15	7
P-28	Near Red Lodge	11	0	5	6	16	0	7	9	12	0	5	7	23	0	9	14
P-7	Near Missoula	9	1	3	5	13	1	4	8	14	1	6	7	24	1	10	13
P-5	South of Arlee	10	1	5	4	16	1	6	9	23	2	7	14	48	2	15	31
P-5	Curve Near Ravalli	8	1	3	4	12	1	5	6	11	1	4	6	17	2	6	9
P-8	West of Townsend	13	0	6	7	16	0	6	10	21	0	9	12	32	0	12	20
P-1	Near Havre	9	0	4	5	15	0	6	9	20	0	7	13	38	0	12	26
P-24	Rainbow Bend	5	1	0	4	13	2	2	9	6	1	0	5	17	2	3	12
P-5	Near Polson	11	1	5	5	12	1	6	5	16	1	6	9	25	2	8	15
P-50	Near Big Sky	17	0	6	11	29	0	12	17	18	0	6	12	34	0	13	21
P-14	Deep Creek Canyon	8	0	6	2	8	0	6	2	8	0	6	2	8	0	6	2
P-1	Corum-Hungry Horse	13	0	3	10	17	0	5	12	17	0	4	13	34	0	11	23
P-7	Near Missoula	40	0	17	23	58	1	24	33	61	0	26	35	93	1	38	54
P-6	Plains to Paradise	10	0	5	5	13	0	5	8	11	1	5	5	15	1	5	9
S-205	Bozeman-Belgrade	13	0	8	5	17	0	9	8	15	0	8	7	22	0	12	10
P-82	Big Fork-Somers	11	1	5	5	13	1	7	5	11	1	5	5	16	1	7	8
P-1	Columbia Heights-E	12	0	3	9	15	0	5	10	15	0	5	10	19	0	7	12
SUB-TOTALS BY TYPE OF DELINEATOR																	
	TYPE I	62	2	33	27	87	3	42	42	83	2	42	39	153	6	67	80
	TYPE II	49	3	21	25	72	3	27	42	89	4	33	52	159	5	55	99
	TYPE III	54	2	20	32	79	3	31	45	65	2	22	41	118	4	41	73
	TYPE IV	86	1	38	47	116	2	50	64	113	2	49	62	165	3	69	93
	TOTAL ALL AREAS	251	8	112	131	354	11	150	193	350	10	146	194	595	18	232	345

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TABLE III 'AFTER' ACCIDENT DATA

ROUTE	LOCATION-DESCRIPTION	NIGHTTIME RUN-OFF-THE-ROADWAY				RUN-OFF-THE-ROADWAY				NIGHTTIME				ALL ACCIDENTS			
		TOTAL	FATAL	INJ.	P.D.	TOTAL	FATAL	INJ.	P.D.	TOTAL	FATAL	INJ.	P.D.	TOTAL	FATAL	INJ.	P.D.
P-7	Near Missoula	2	0	1	1	2	0	1	1	2	0	1	1	2	0	1	1
P-5	Evaro Hill	3	0	1	2	3	0	1	2	4	0	1	3	4	0	1	3
P-1	Kalispell	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1
P-1	Near Cut Bank	2	1	1	0	2	1	1	0	2	1	1	0	3	1	2	0
P-28	Near Red Lodge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-7	Near Missoula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-5	South of Arlee	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	2
P-5	Curve Near Ravalli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-8	West of Townsend	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
P-1	Near Havre	0	0	0	0	0	0	0	0	1	0	0	1	5	0	0	5
P-24	Rainbow Bend	5	0	2	3	13	0	6	7	6	0	2	4	16	0	6	10
P-5	Near Polson	1	0	0	1	1	0	0	1	1	0	0	1	3	0	0	3
P-50	Near Big Sky	2	0	1	1	4	0	3	1	2	0	1	1	5	0	4	1
P-14	Deep Creek Canyon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-1	Corum-Hungry Horse	9	0	3	6	22	0	10	12	15	2	4	9	40	2	16	22
P-7	Near Missoula	2	0	1	1	2	0	1	1	3	0	1	2	5	0	2	3
P-6	Plains to Paradise	1	0	1	0	3	0	1	2	2	0	1	1	4	0	1	3
S-205	Bozeman-Belgrade	1	0	1	0	3	0	1	2	1	0	1	0	3	0	1	2
P-82	Big Fork-Somers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-1	Columbia Heights-E.	0	0	0	0	1	0	1	0	0	0	0	0	4	0	1	3
SUB-TOTALS	BY TYPE OF DELINEATOR																
	TYPE I	7	1	3	3	7	1	3	3	9	1	3	5	10	1	4	5
	TYPE II	0	0	0	0	0	0	0	0	2	0	0	2	8	0	0	8
	TYPE III	17	0	6	11	40	0	19	21	24	2	7	15	64	2	26	36
	TYPE IV	4	0	3	1	9	0	4	5	6	0	3	3	16	0	5	11
	TOTAL ALL AREAS	28	1	12	15	56	1	26	29	41	3	13	25	98	3	35	60

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TABLE IV ACCIDENT RATES

TYPE OF DELINEATOR	NIGHT-RUN-OFF-ROAD			RUN-OFF-THE-ROAD			NIGHT-TIME			ALL ACCIDENTS		
	BEFORE	AFTER	% CHANGES	BEFORE	AFTER	% CHANGE	BEFORE	AFTER	% CHANGE	BEFORE	AFTER	% CHANGE
I	5.30	6.00	+13.2	7.43	6.00	-19.2	7.09	7.72	+8.9	13.07	8.58	-34.4
II	4.02	0.00	-100.0	5.91	0.00	-100.0	7.31	1.45	-80.2	13.05	5.79	-55.6
III	7.00	5.81	-17.0	10.24	13.68	+33.6	8.43	8.21	-2.6	15.30	21.89	+43.1
IV	7.05	3.33	-52.0	9.52	7.50	-21.2	9.27	4.50	-51.5	13.53	13.33	-1.5
ALL	5.65	3.79	-32.9	7.97	7.58	-5.9	7.88	5.55	-29.6	13.40	13.27	-1.0

POISSON TEST
OF
STATISTICAL SIGNIFICANCE

DELINEATOR TYPE I

ACCIDENT GROUP	PERCENT REDUCTION OF ACC.	80% LEVEL OF CONFIDENCE	IS THIS SIGNIFICANT YES/NO
NIGHTTIME RUN-OFF-THE-ROAD	+13.2	11	no
RUN-OFF-THE-ROADWAY	19.2	10	yes
NIGHTTIME	+ 8.9	10	no
ALL ACCIDENTS	34.4	6	yes

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POISSON TEST
OF
STATISTICAL SIGNIFICANCE

DELINEATOR TYPE II

ACCIDENT GROUP	PERCENT REDUCTION OF ACC.	80% LEVEL OF CONFIDENCE	IS THIS SIGNIFICANT YES/NO
NIGHTTIME RUN-OFF-THE-ROAD	100	12.5	yes
RUN-OFF-THE-ROADWAY	100	10.5	yes
NIGHTTIME	80.2	10	yes
ALL ACCIDENTS	55.6	5	yes

mp/203 H2

POISSON TEST
OF
STATISTICAL SIGNIFICANCE

DELINEATOR TYPE III

ACCIDENT GROUP	PERCENT REDUCTION OF ACC.	80% LEVEL OF CONFIDENCE	IS THIS SIGNIFICANT YES/NO
NIGHTTIME RUN-OFF-THE-ROAD	17.0	12	yes
RUN-OFF-THE-ROADWAY	+33.6	10.5	no
NIGHTTIME	2.6	11	no
ALL ACCIDENTS	+43.1	7.5	no

mp/203 H3

POISSON TEST
OF
STATISTICAL SIGNIFICANCE

DELINEATOR TYPE IV

ACCIDENT GROUP	PERCENT REDUCTION OF ACC.	80% LEVEL OF CONFIDENCE	IS THIS SIGNIFICANT YES/NO
NIGHTTIME RUN-OFF-THE-ROAD	52.0	10	yes
RUN-OFF-THE-ROADWAY	21.2	7.5	yes
NIGHTTIME	51.5	8	yes
ALL ACCIDENTS	1.5	5	no

mp/203 H4

POISSON TEST
OF
STATISTICAL SIGNIFICANCE

ALL DELINEATORS

ACCIDENT GROUP	PERCENT REDUCTION OF ACC.	80% LEVEL OF CONFIDENCE	IS THIS SIGNIFICANT YES/NO
NIGHTTIME RUN-OFF-THE-ROADWAY	32.9	4	yes
RUN-OFF-THE-ROADWAY	5.9	3	yes
NIGHTTIME	29.6	2	yes
ALL ACCIDENTS	1.0	1	yes

mp/203 H5

TABLE V

DELINEATOR TYPE III - 4 AREAS

RAINBOW BEND
NEAR POLSON
NEAR BIG SKY
DEEP CREEK CANYON

			Night-Runoff the road		Run-off-the-road		Night-time		All Accidents	
	ADT	LENGTH	# ACC.	ACC. RATE	# ACC.	ACC. RATE	# ACC.	ACC. RATE	# ACC.	ACC. RATE
BEFORE	1929	3.8	41	10.2	62	15.4	48	11.9	84	20.9
AFTER	2373.8	3.8	8	5.2	18	11.6	9	5.8	24	15.5
% CHANGE				-49.0		-24.7		-51.3		-25.8

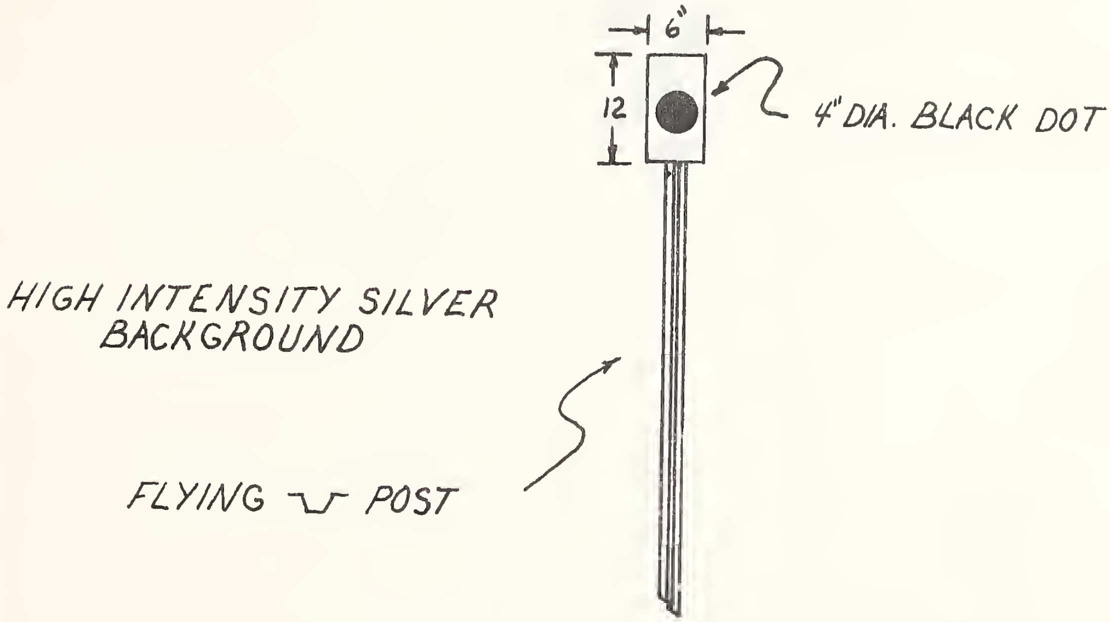
This chart shows the results from 4 of the study areas with Type III delineation. The Corum-Hungry Horse study area is not included.

mp/203J

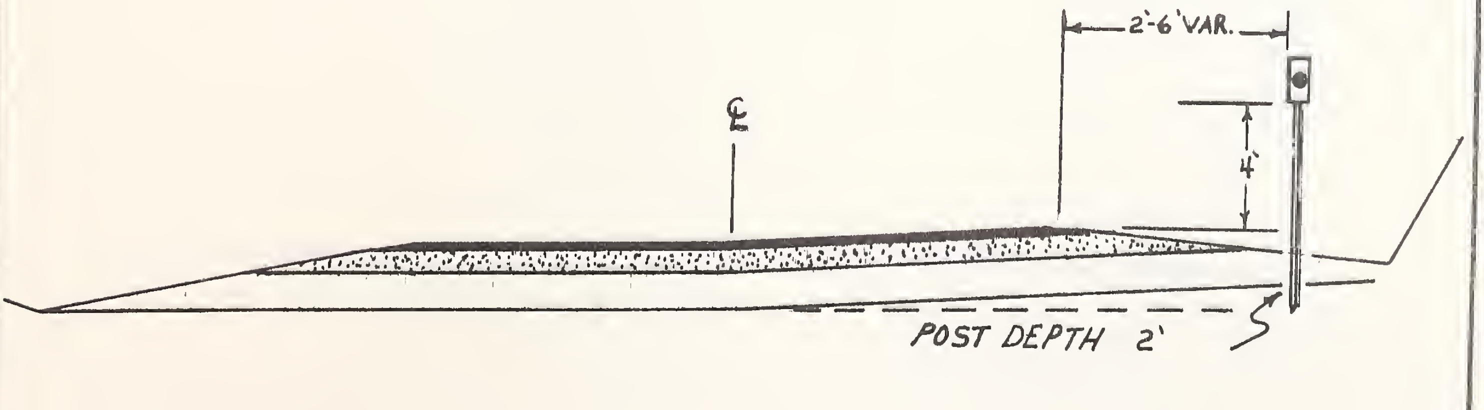
TYPICAL DETAILS

LOCATION PLANS

TYPE I DESIGN



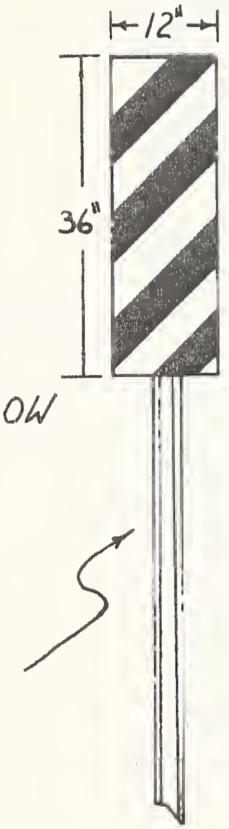
TYPICAL DELINEATOR PLACEMENT



DRAWING NOT TO SCALE

4-79

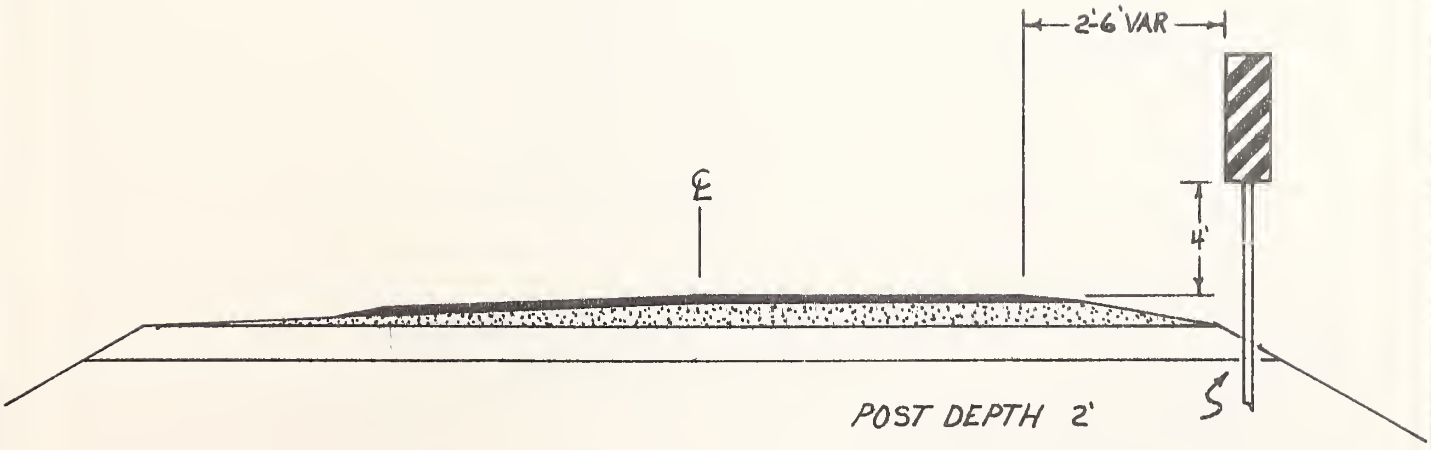
TYPE II DESIGN



HIGH INTENSITY YELLOW
WITH BLACK STRIPING

FLYING V POST

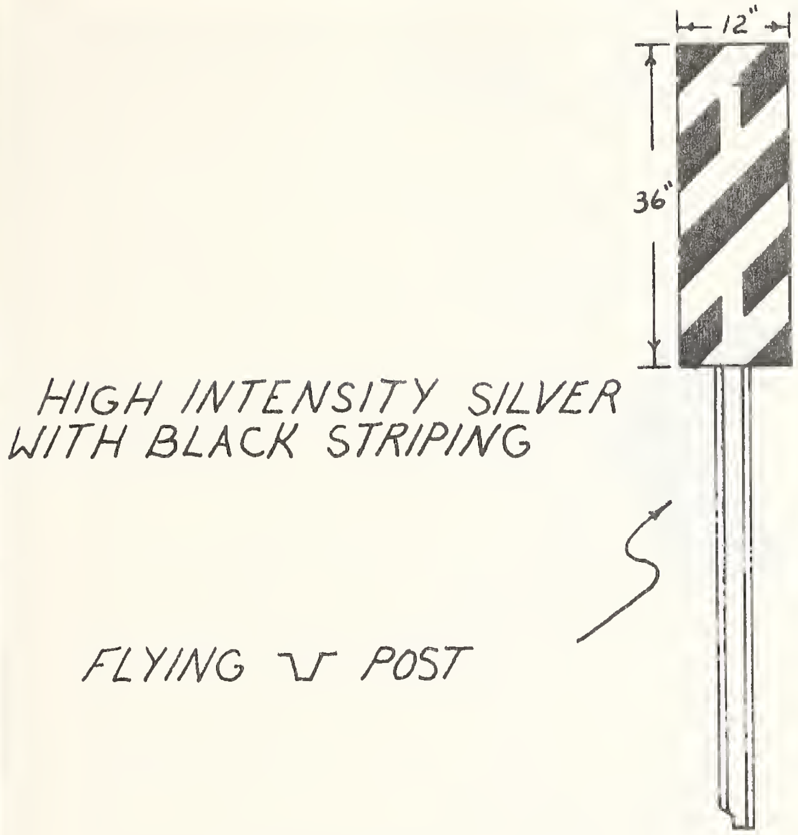
TYPICAL DELINEATOR PLACEMENT



POST DEPTH 2'

DRAWING NOT TO SCALE
4-79

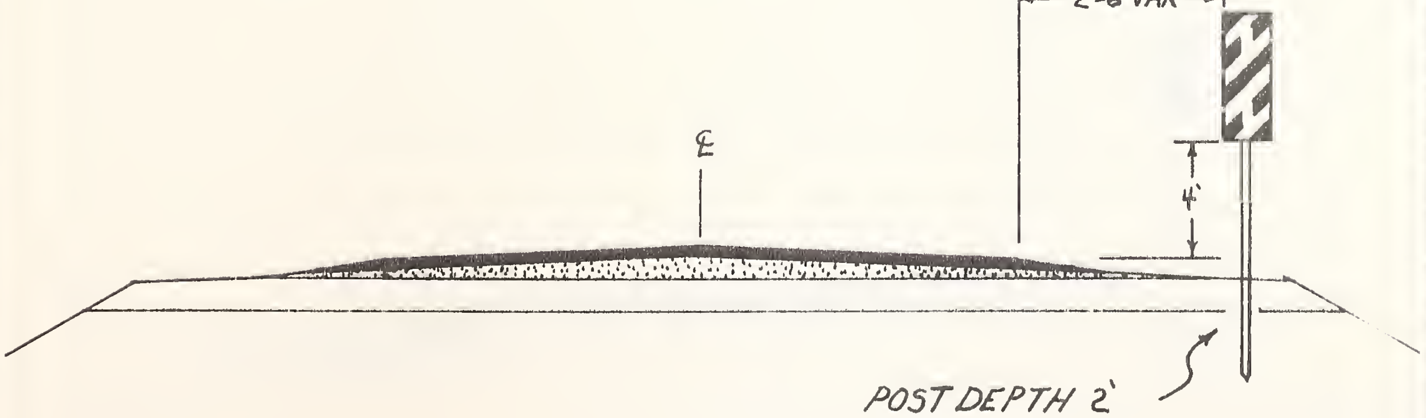
TYPE III DESIGN



HIGH INTENSITY SILVER
WITH BLACK STRIPING

FLYING V POST

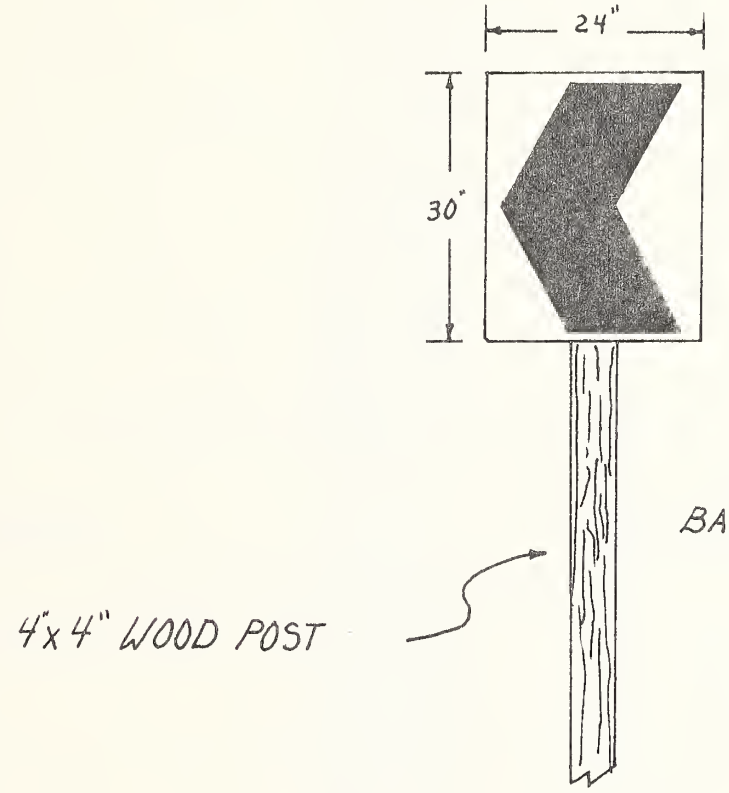
TYPICAL DELINEATOR PLACEMENT



POST DEPTH 2'

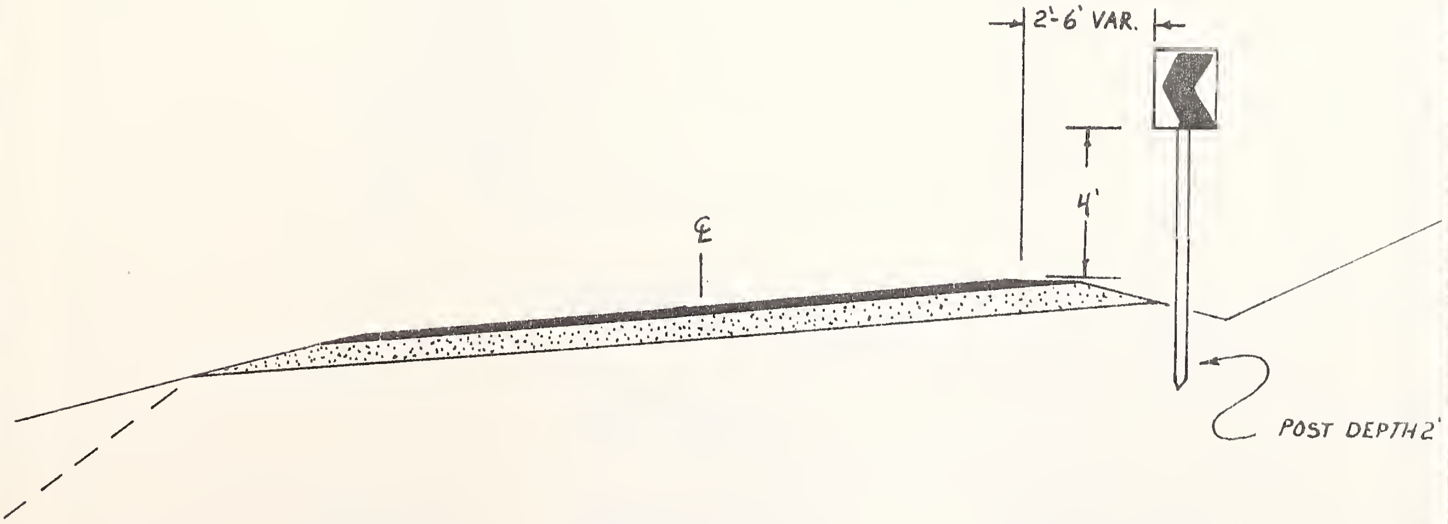
DRAWING NOT TO SCALE
4-79

TYPE IV DESIGN

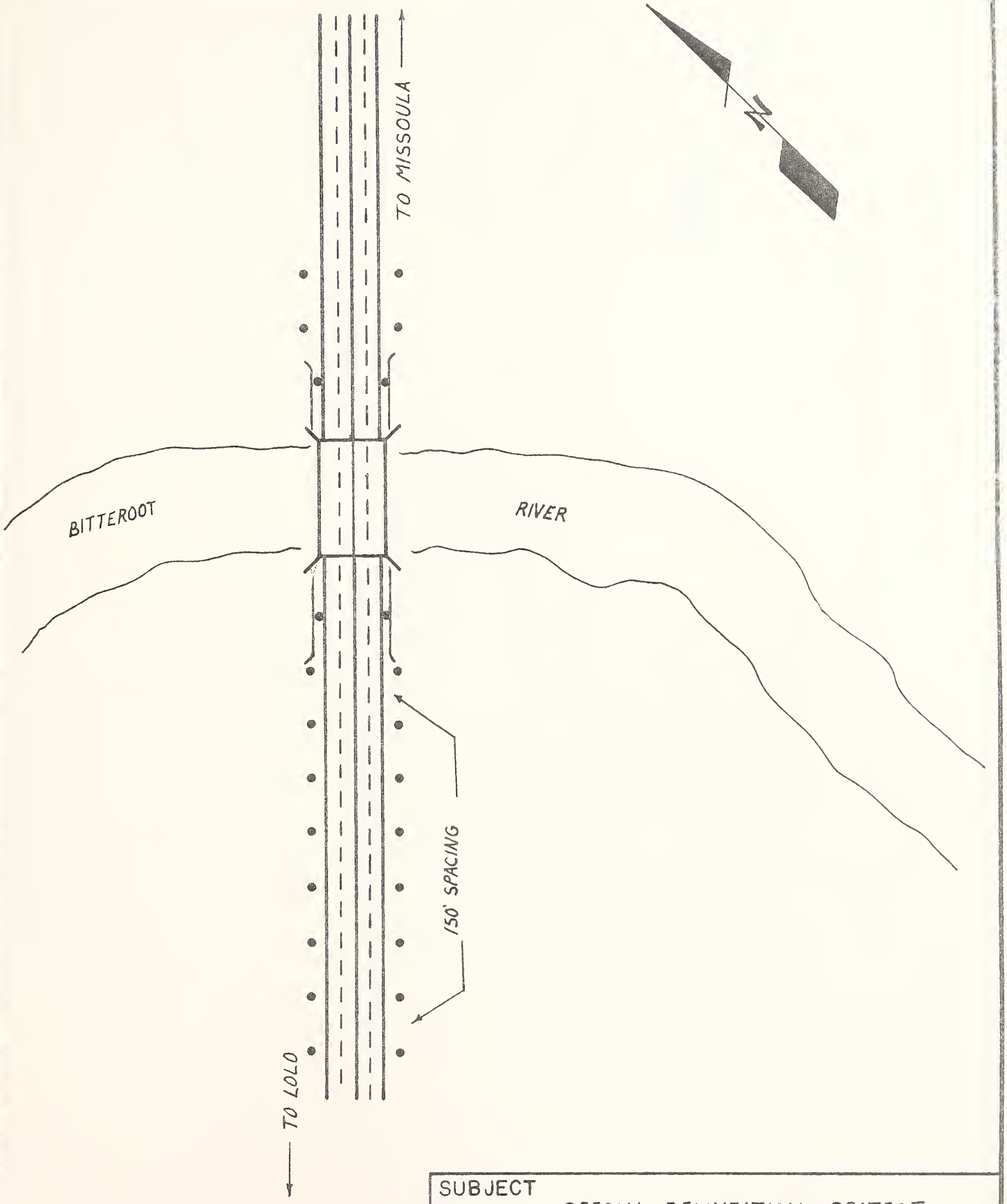


HIGH INTENSITY YELLOW
BACKGROUND WITH BLACK CHEVRON

TYPICAL DELINEATOR PLACEMENT



DRAWING NOT TO SCALE
4-79



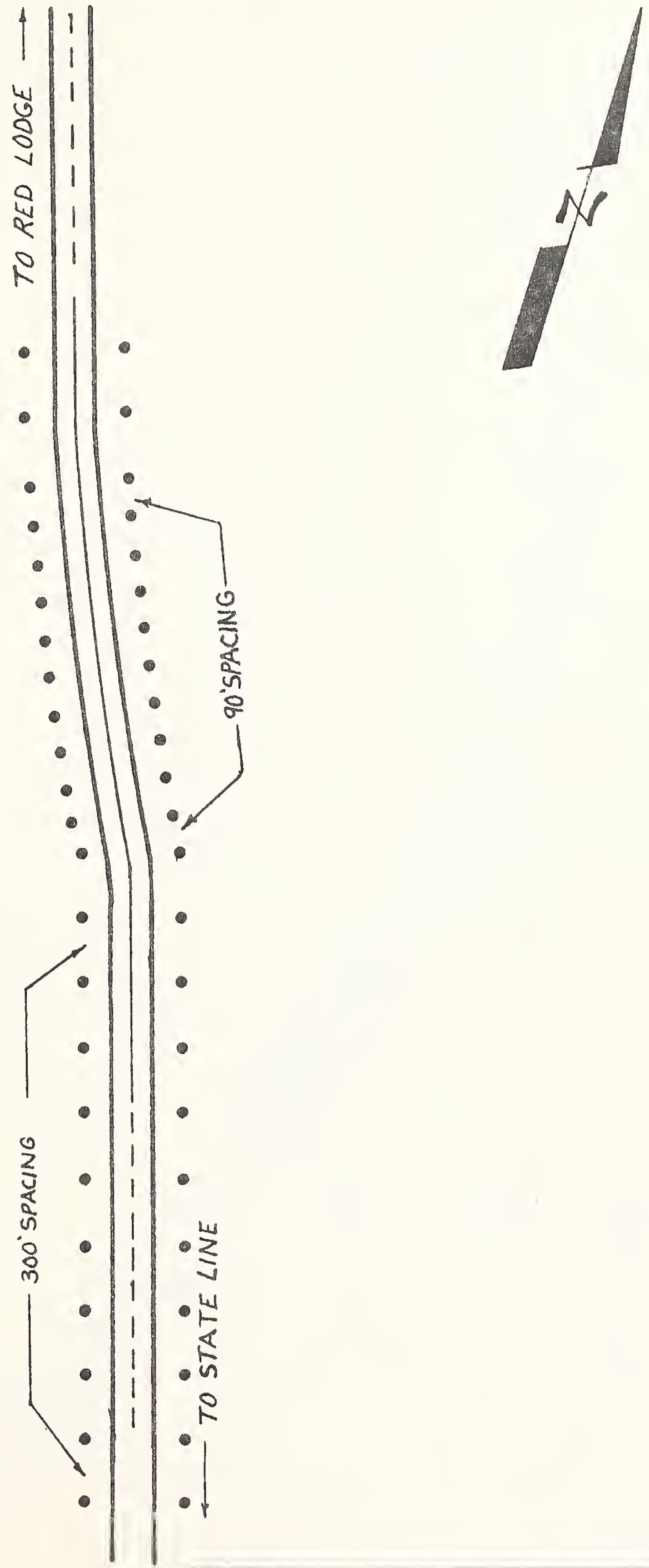
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 93 (FAP 7) MISSOULA — LOLO

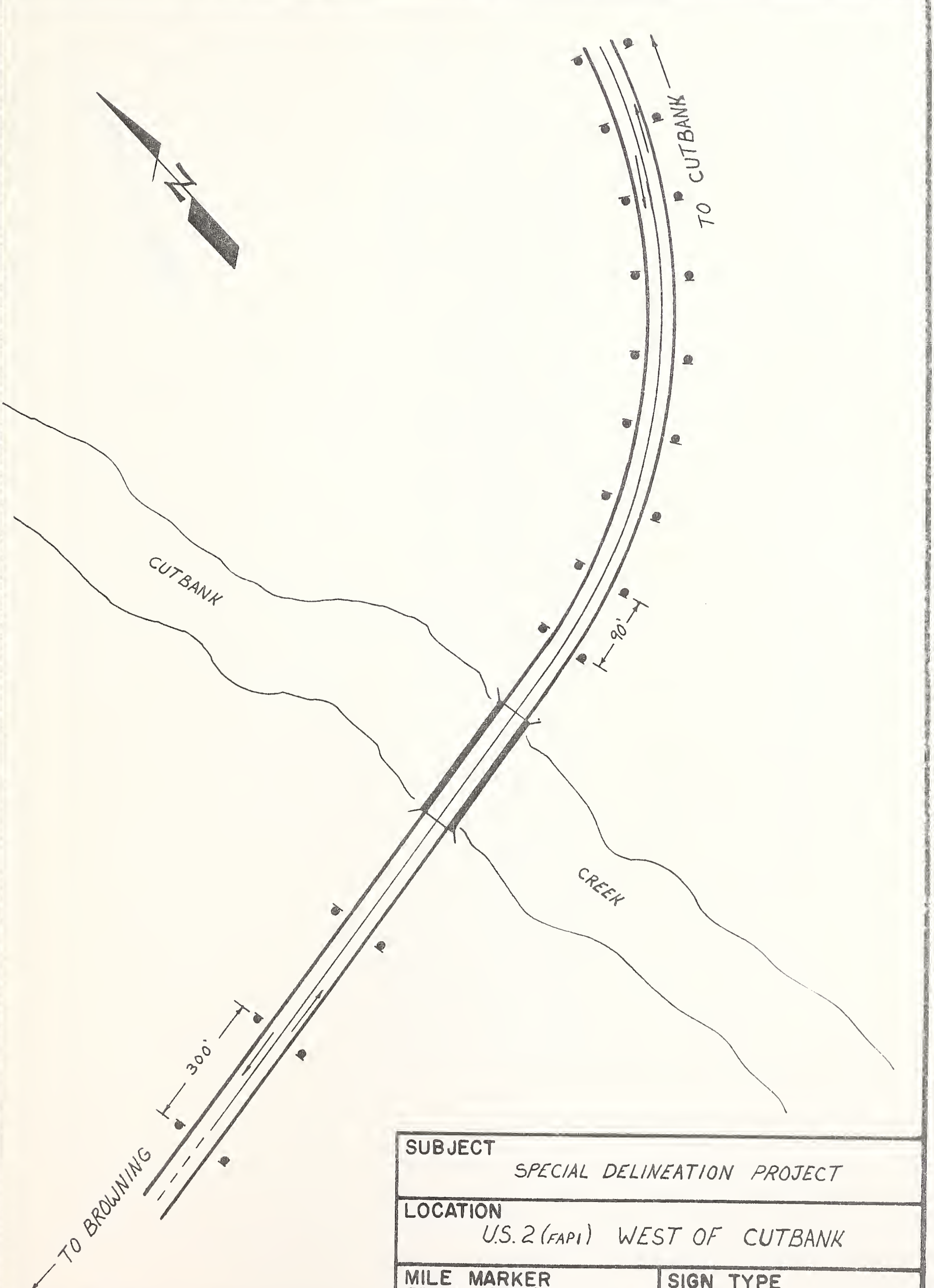
MILE MARKER
FROM : 89.6
TO : 90.2

SIGN TYPE I



NO SCALE

SUBJECT SPECIAL DELINEATION PROJECT	
LOCATION U.S. 212 (FAP 28) NEAR RED LODGE	
MILE MARKER FROM : 70.28 TO : 71.0	SIGN TYPE I

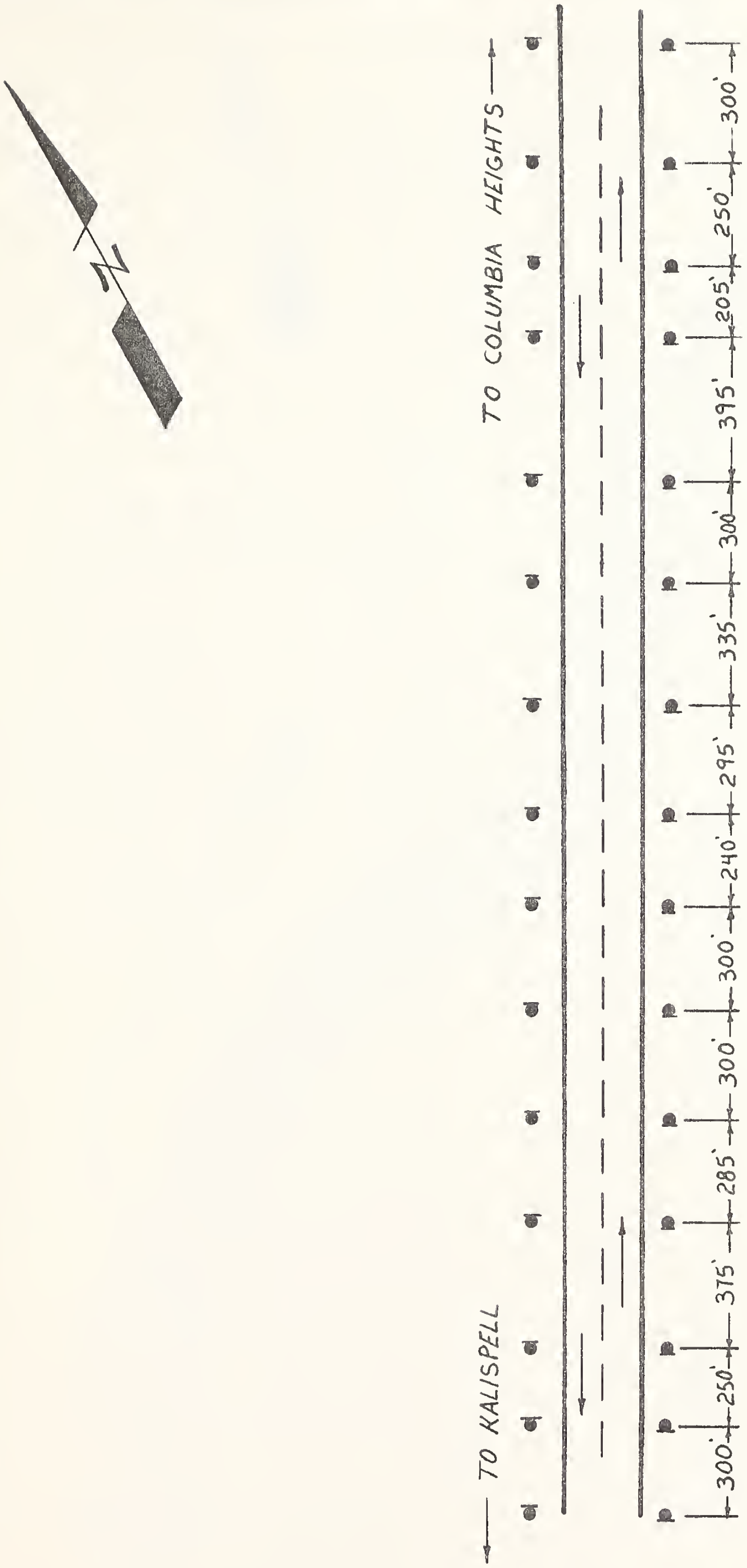


SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 2 (FAP1) WEST OF CUTBANK

MILE MARKER
FROM : 253.8
TO : 254.4

SIGN TYPE
I

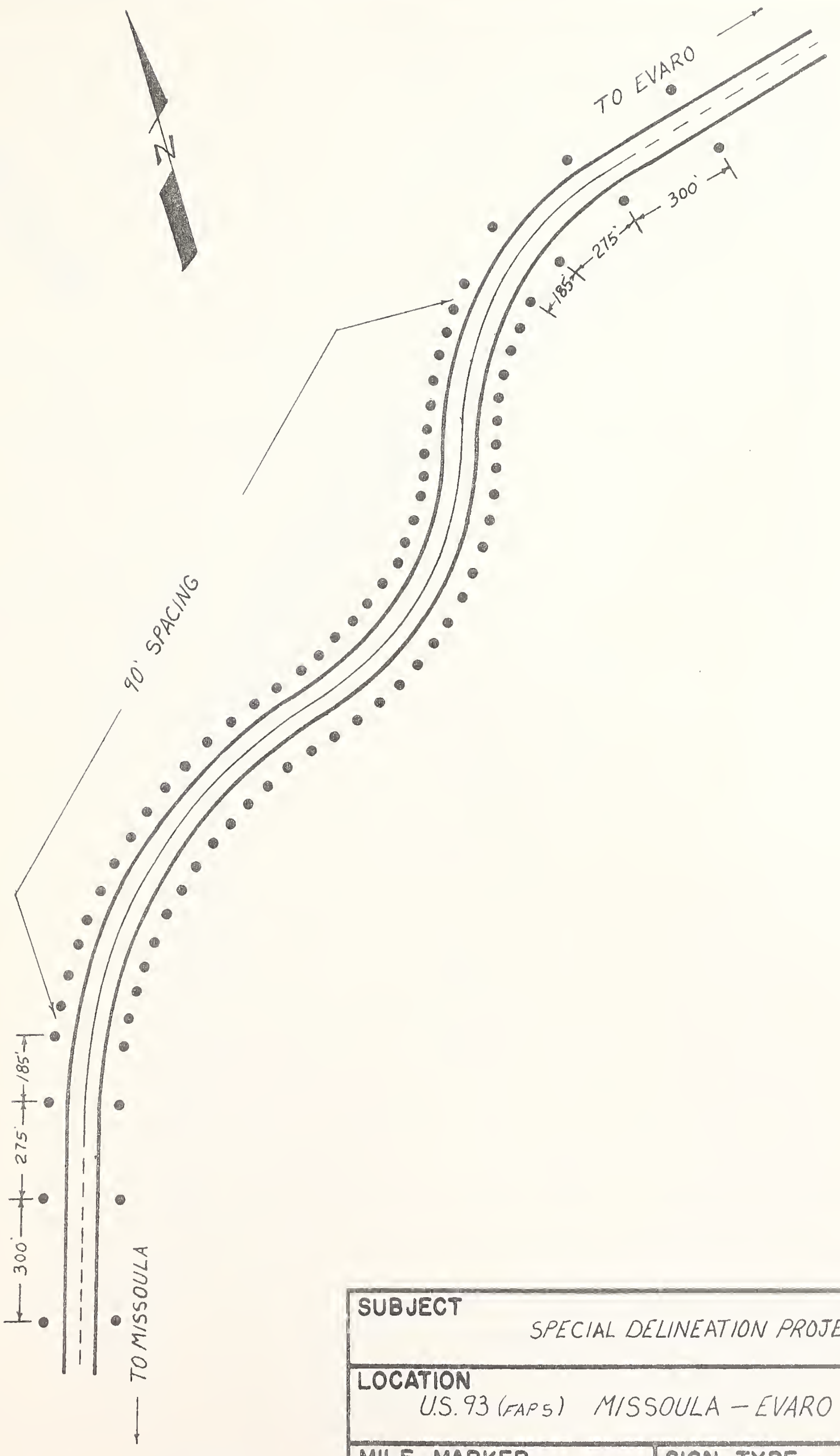


SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 2 (FAP 1) KALISPELL NORTH

MILE MARKER
FROM : 139.0
TO : 139.7

SIGN TYPE
I



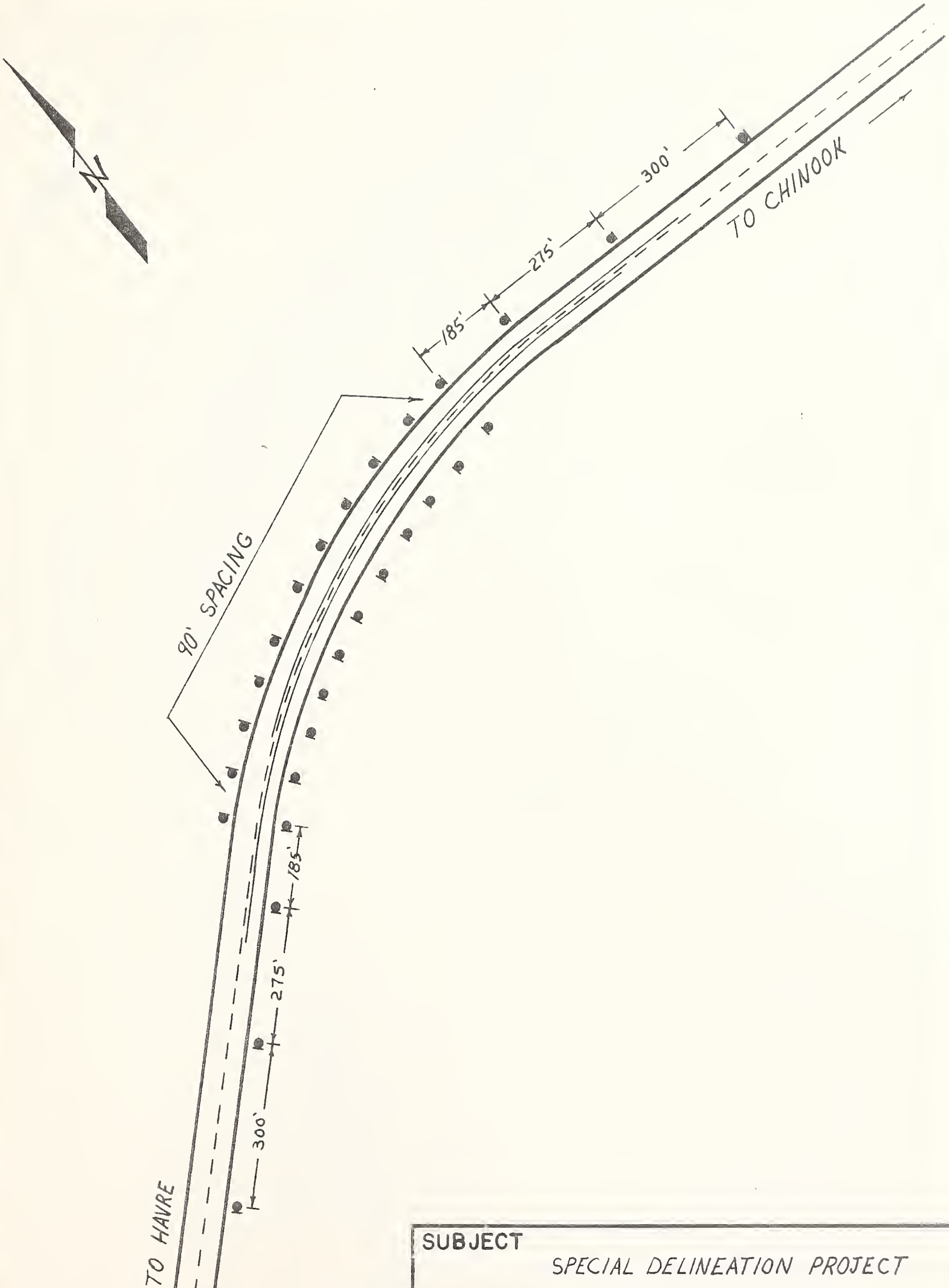
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 93 (FAP 5) MISSOULA – EVARO

MILE MARKER
FROM : 2.98
TO : 5.00

SIGN TYPE
I



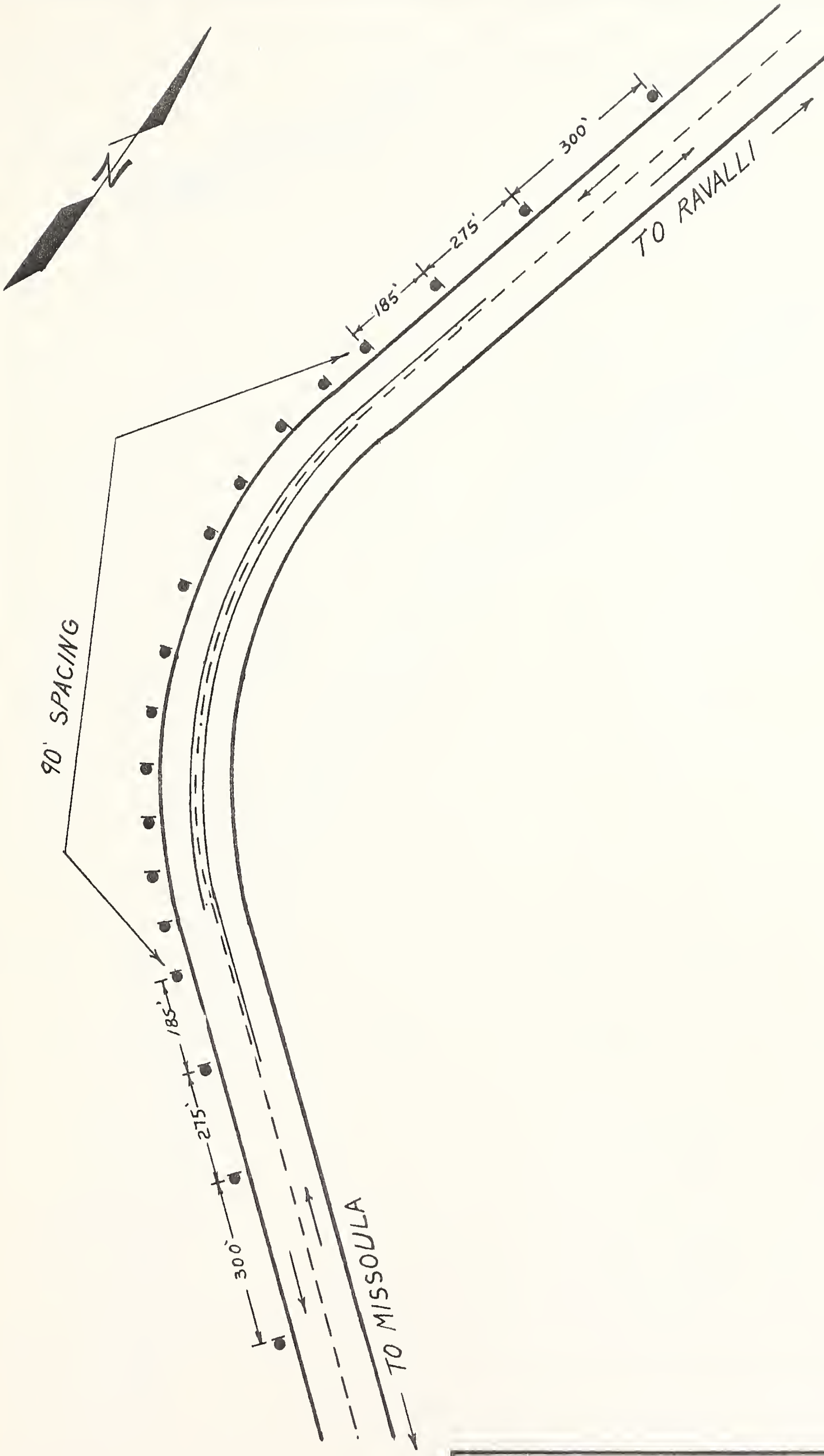
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 2 (FAP 1) EAST HAVRE

MILE MARKER
FROM : 384.4
TO : 385.3

SIGN TYPE
II



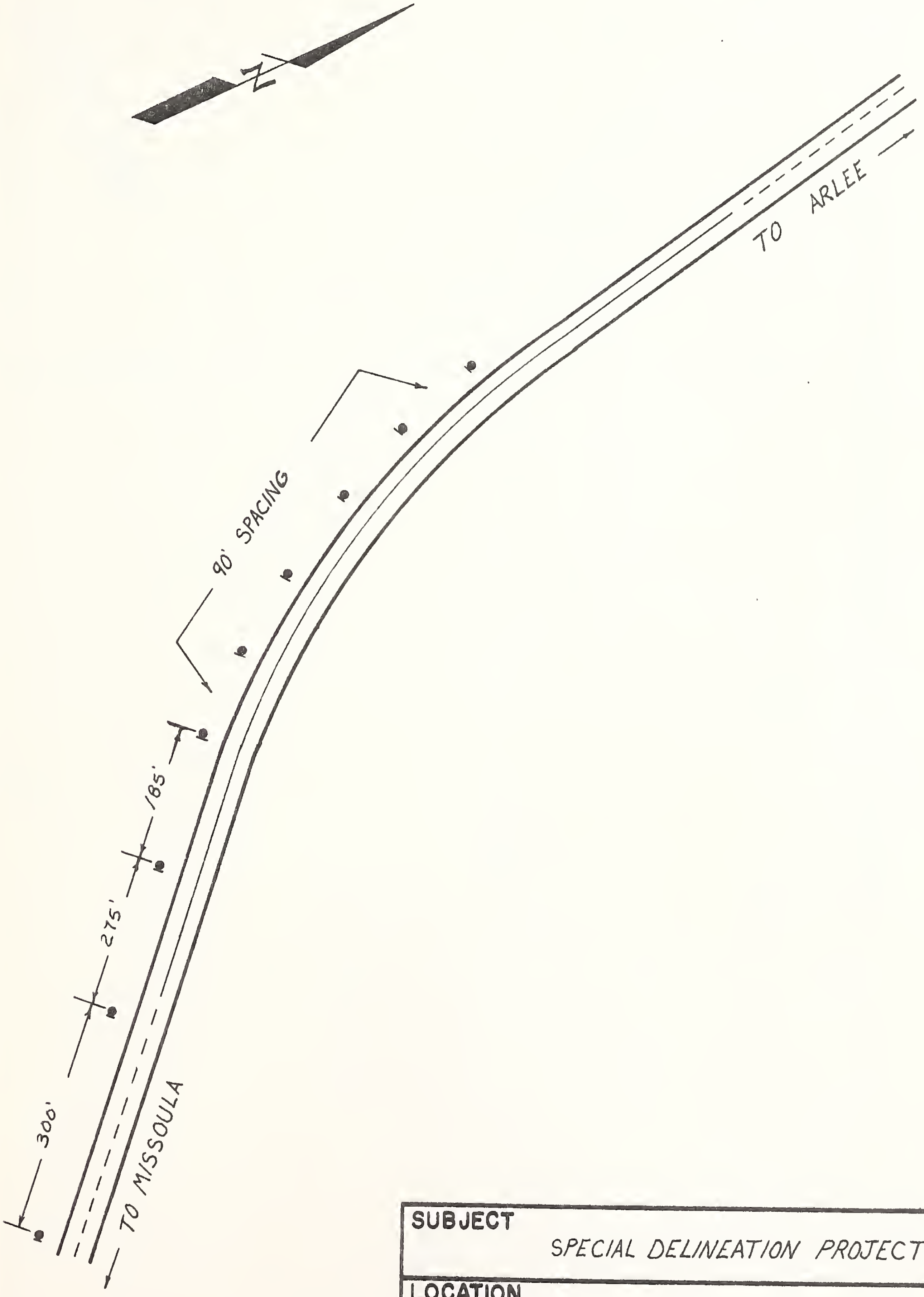
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 93. (FAP 7) MISSOULA — RAVALLI

MILE MARKER
FROM : 24.7
TO : 25.7

SIGN TYPE
II



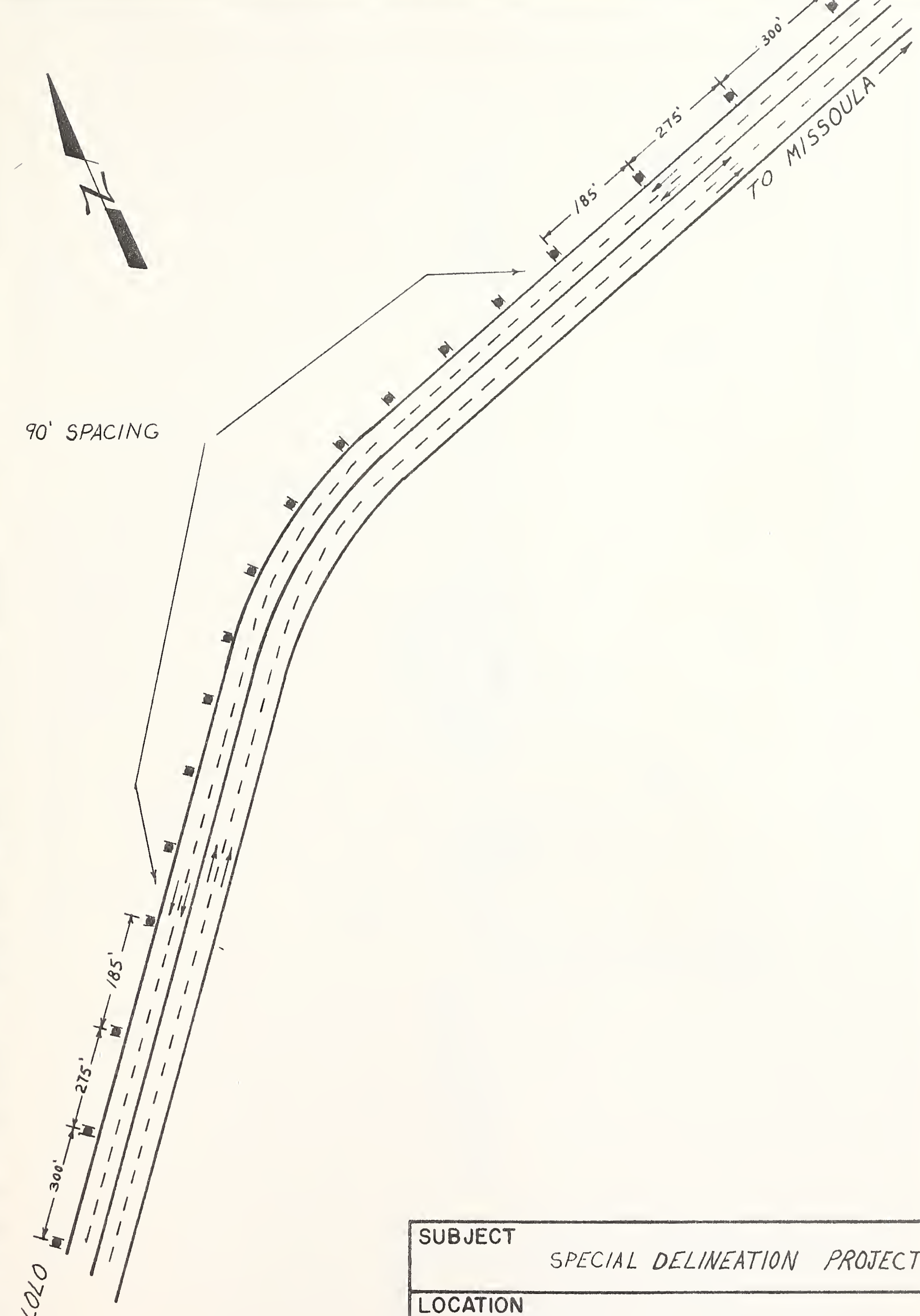
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 93 (FAP5) ARLEE —— MISSOULA

MILE MARKER
FROM 171
TO 176

SIGN TYPE II



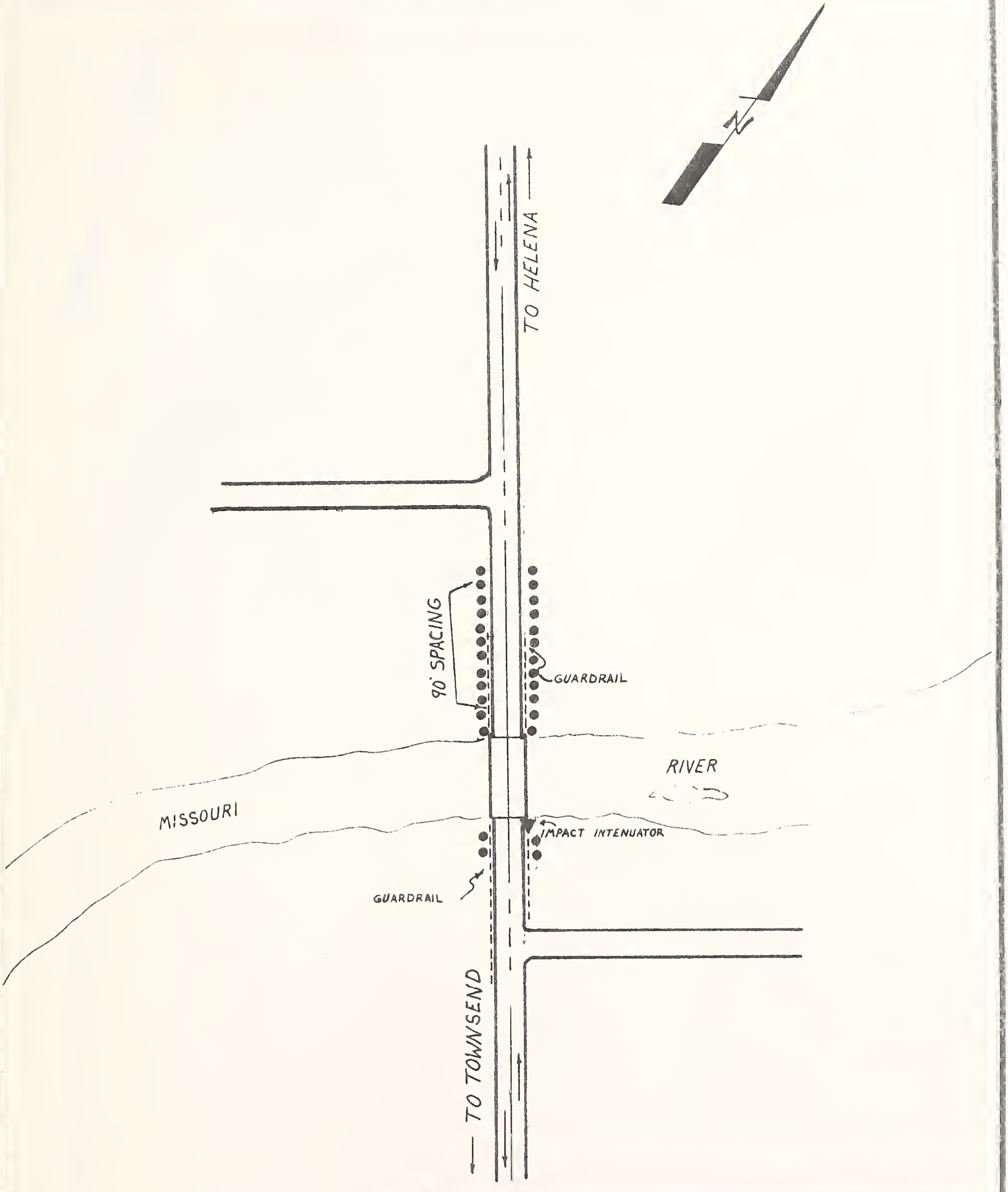
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 93 (FAP 7) MISSOULA → LOLO

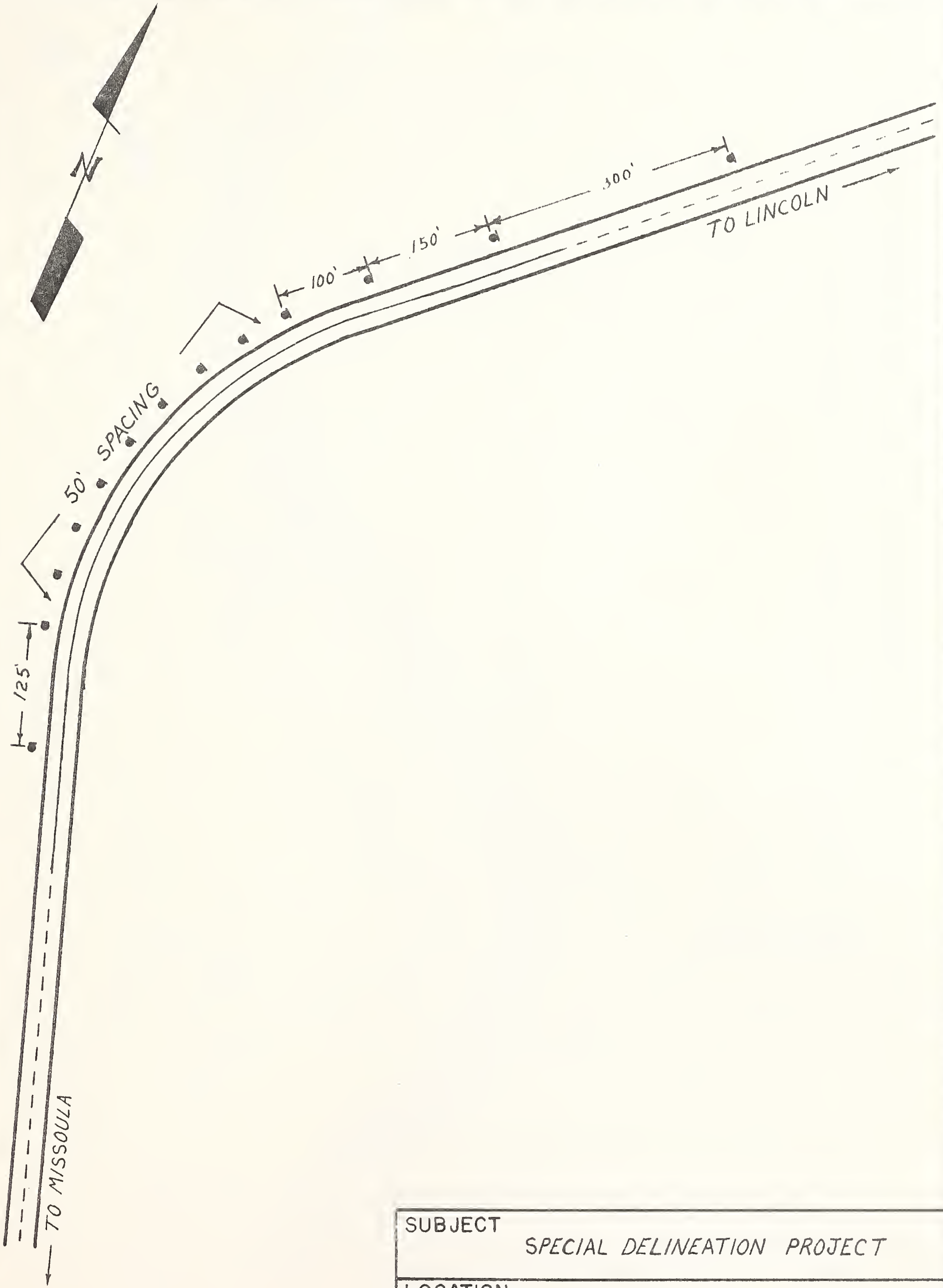
MILE MARKER
FROM : 88.6
TO : 89.3

SIGN TYPE
II



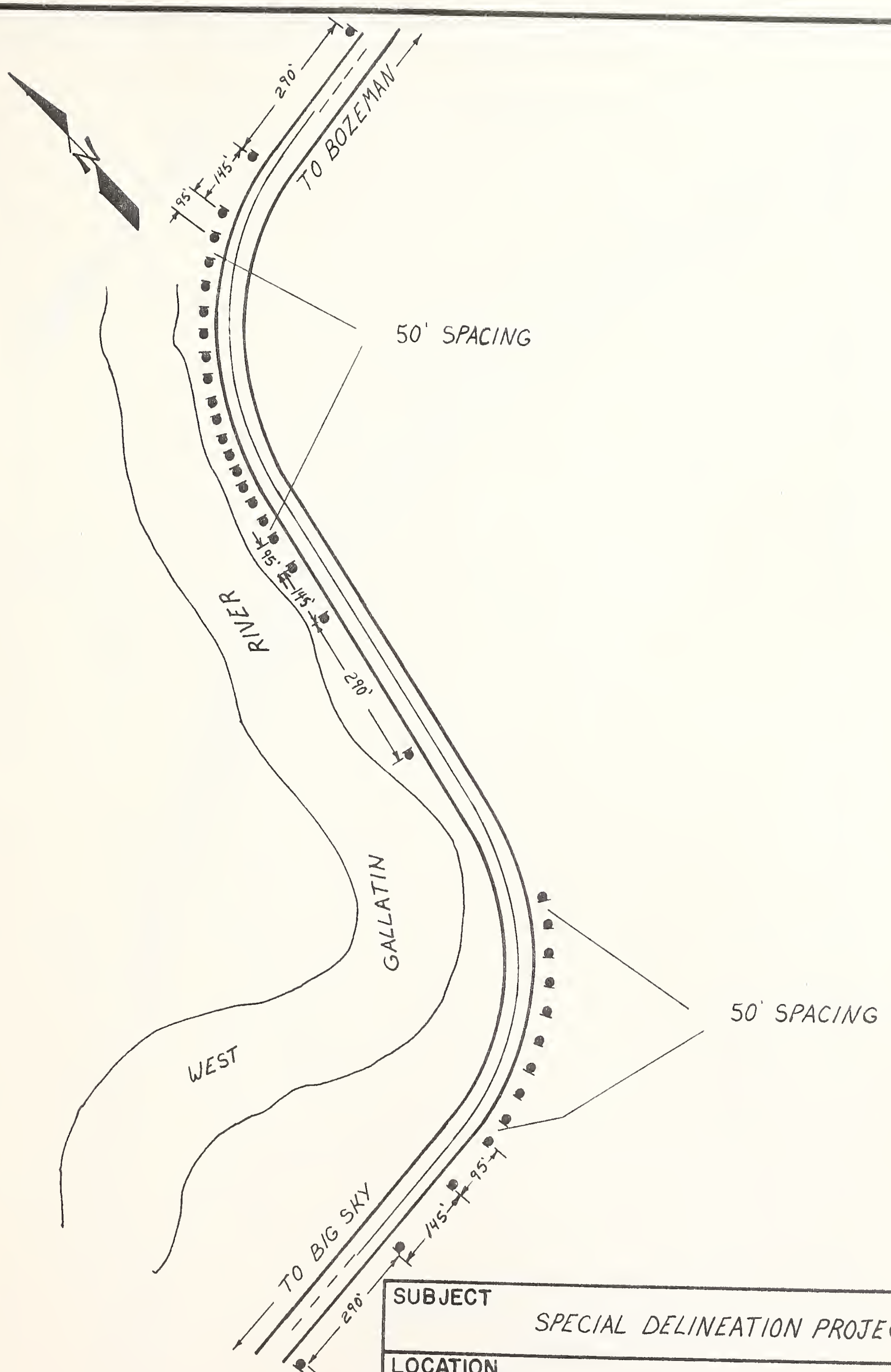
NO SCALE

SUBJECT SPECIAL DELINEATOR PROJECT	
LOCATION U.S. 12 (FAP 8) TOWNSEND – HELENA	
MILE MARKER **FROM** : 75.8 **TO** : 76.4	**SIGN TYPE** II



NO SCALE

SUBJECT SPECIAL DELINEATION PROJECT	
LOCATION MONTANA 200 (FAP 24) RAINBOW BEND	
MILE MARKER FROM : 8.5 TO : 9.0	SIGN TYPE III

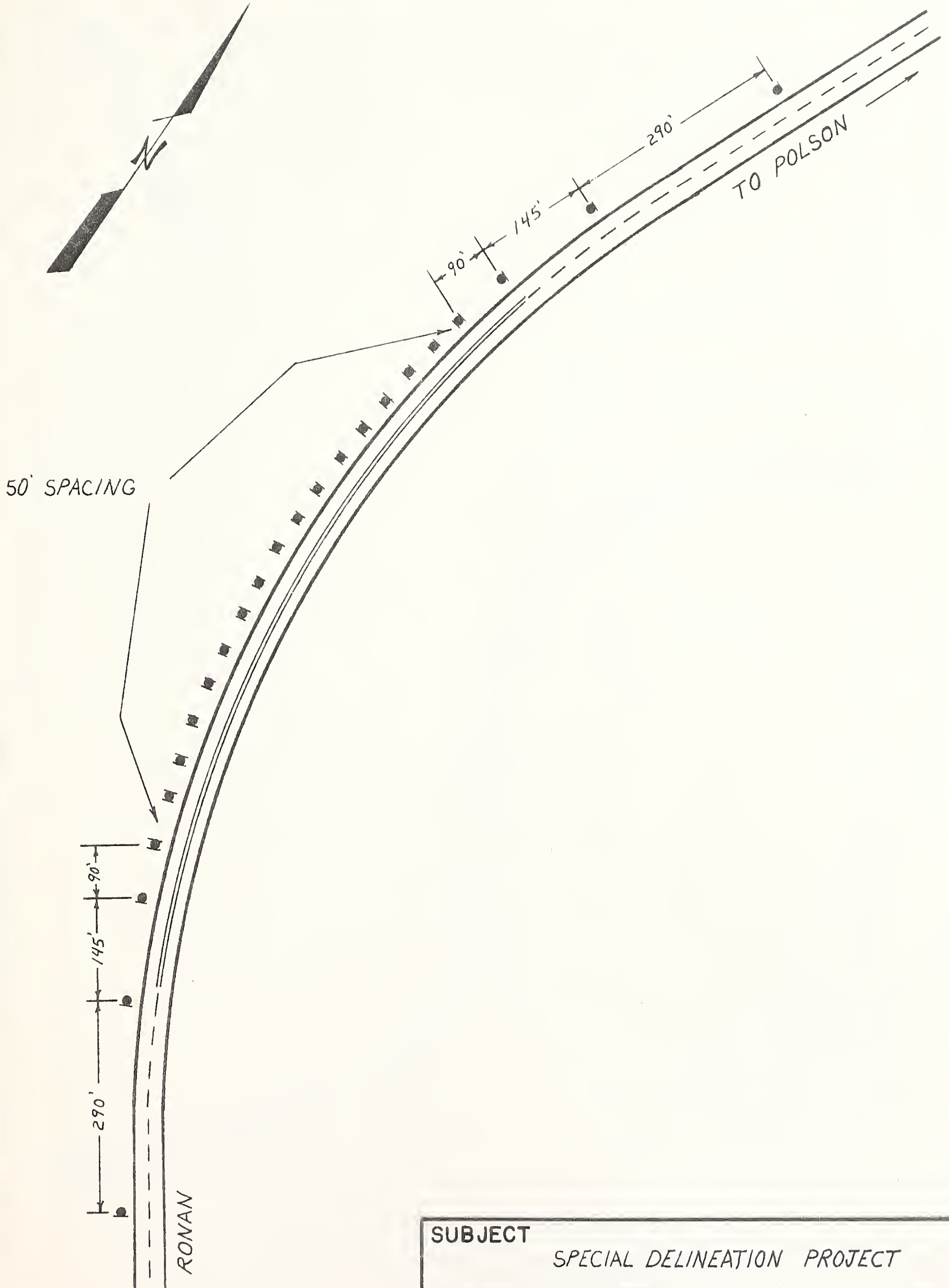


SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 191 (FAP 50) NEAR BIG SKY

MILE MARKER
FROM : 50.4
TO : 51.1

SIGN TYPE
III



SUBJECT

SPECIAL DELINEATION PROJECT

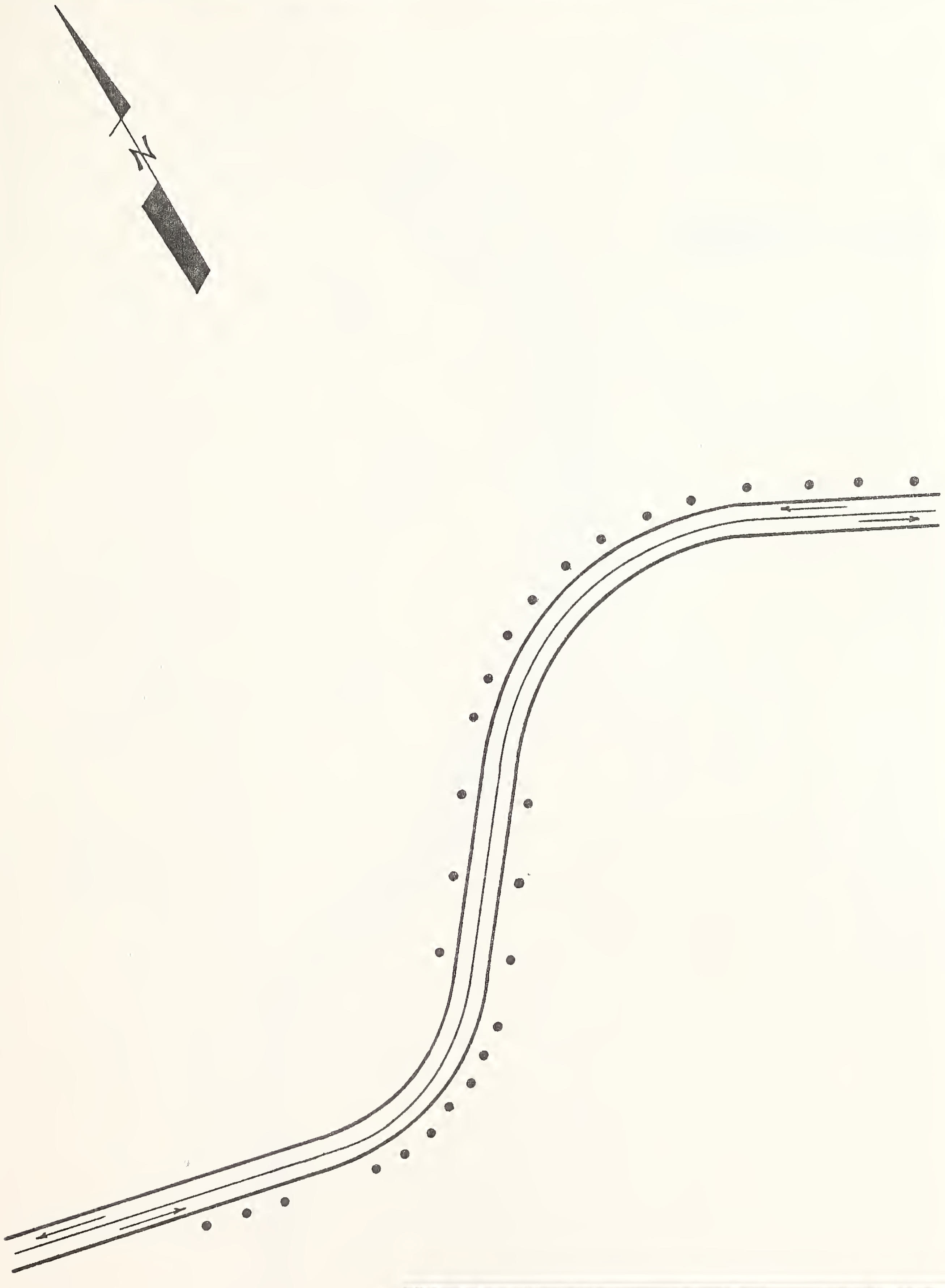
LOCATION

U.S. 93 (FAP 5) RONAN — POLSON

MILE MARKER
FROM : 56.4
TO : 57.2

SIGN TYPE

III



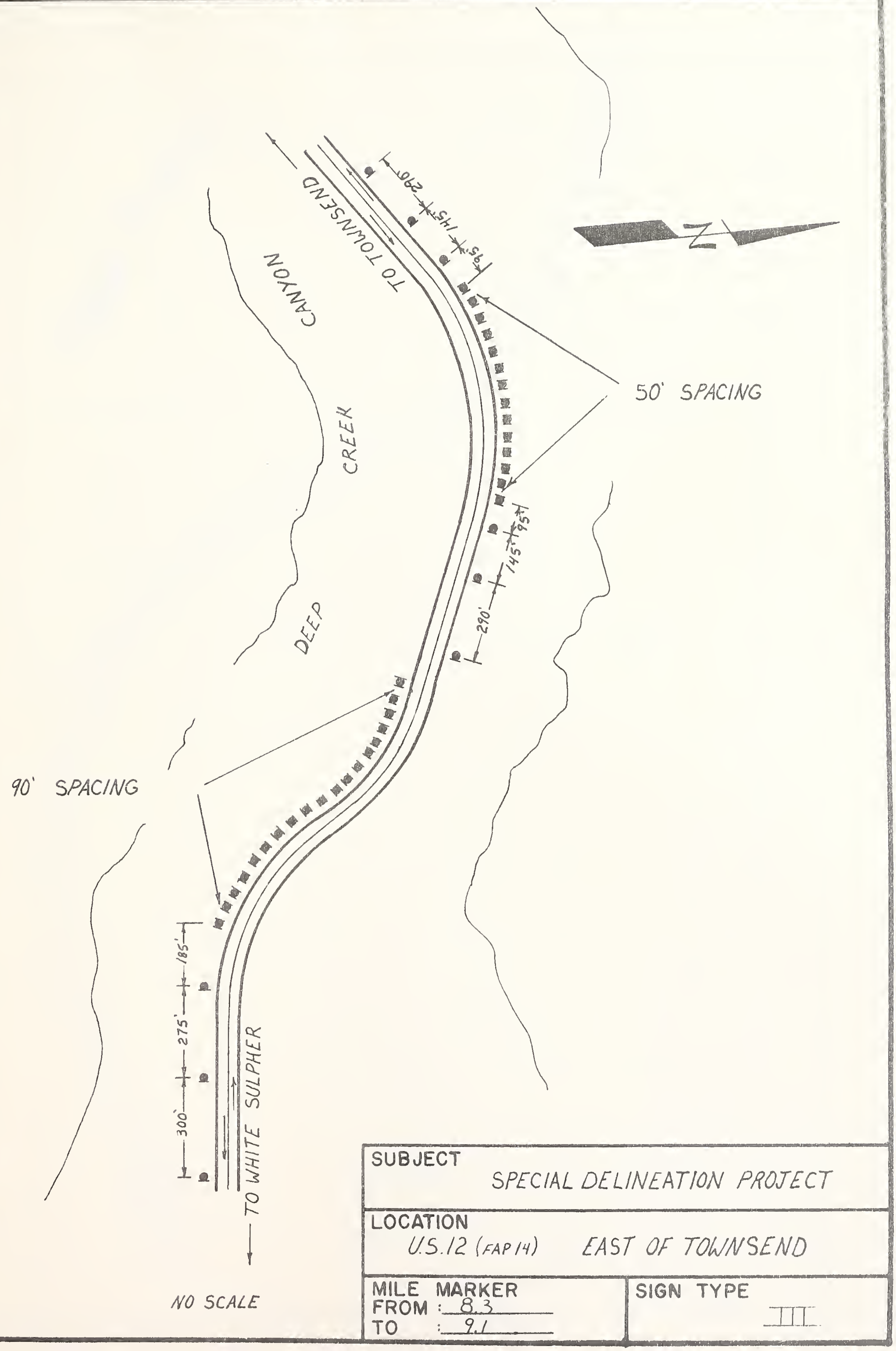
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
US 2 (FAPI) HUNGRY HORSE

MILE MARKER
FROM : 142.3
TO : 143.9

SIGN TYPE
III

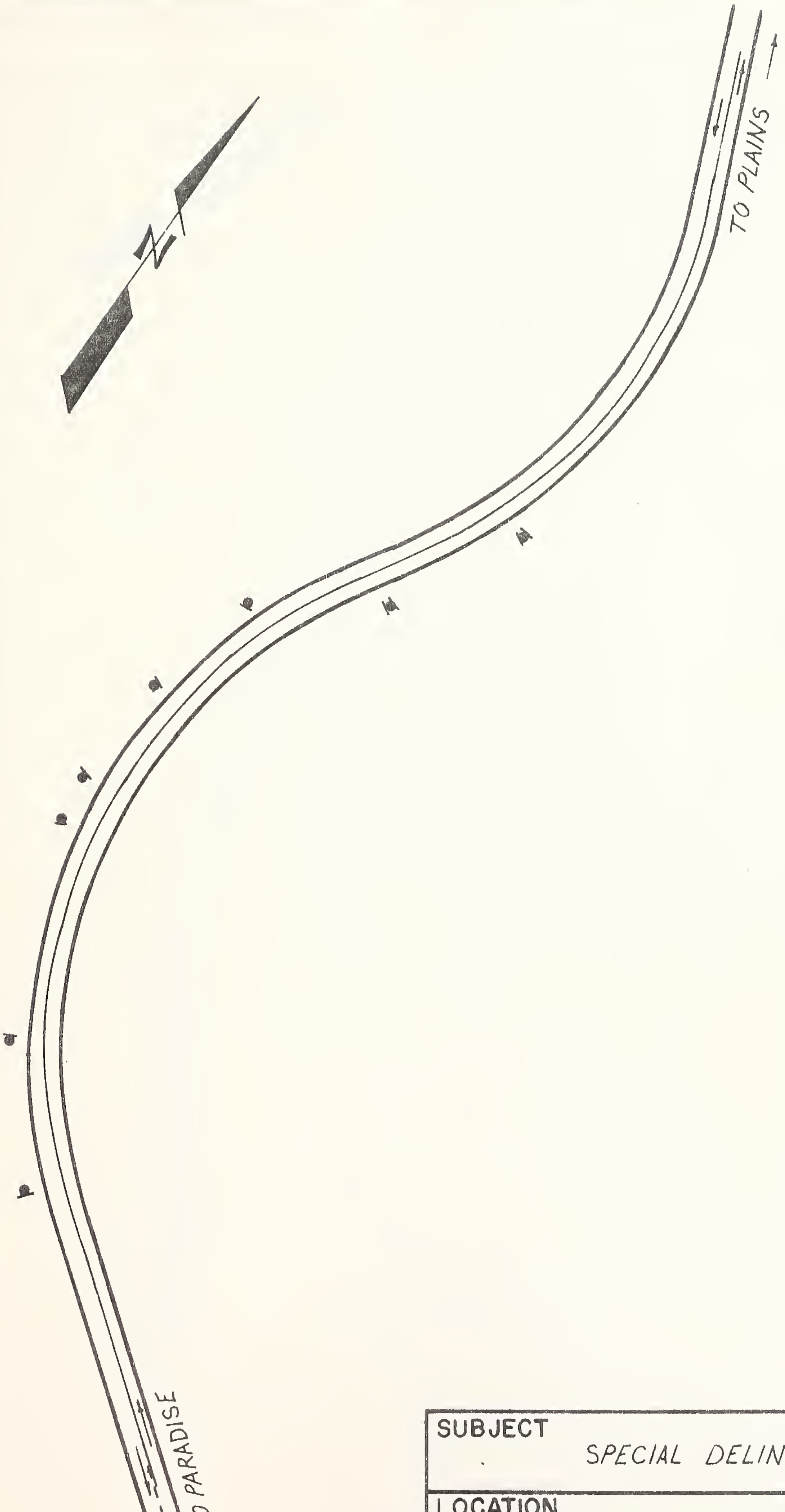


SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 12 (FAP 14) EAST OF TOWNSEND

MILE MARKER
FROM : 8.3
TO : 9.1

SIGN TYPE
III



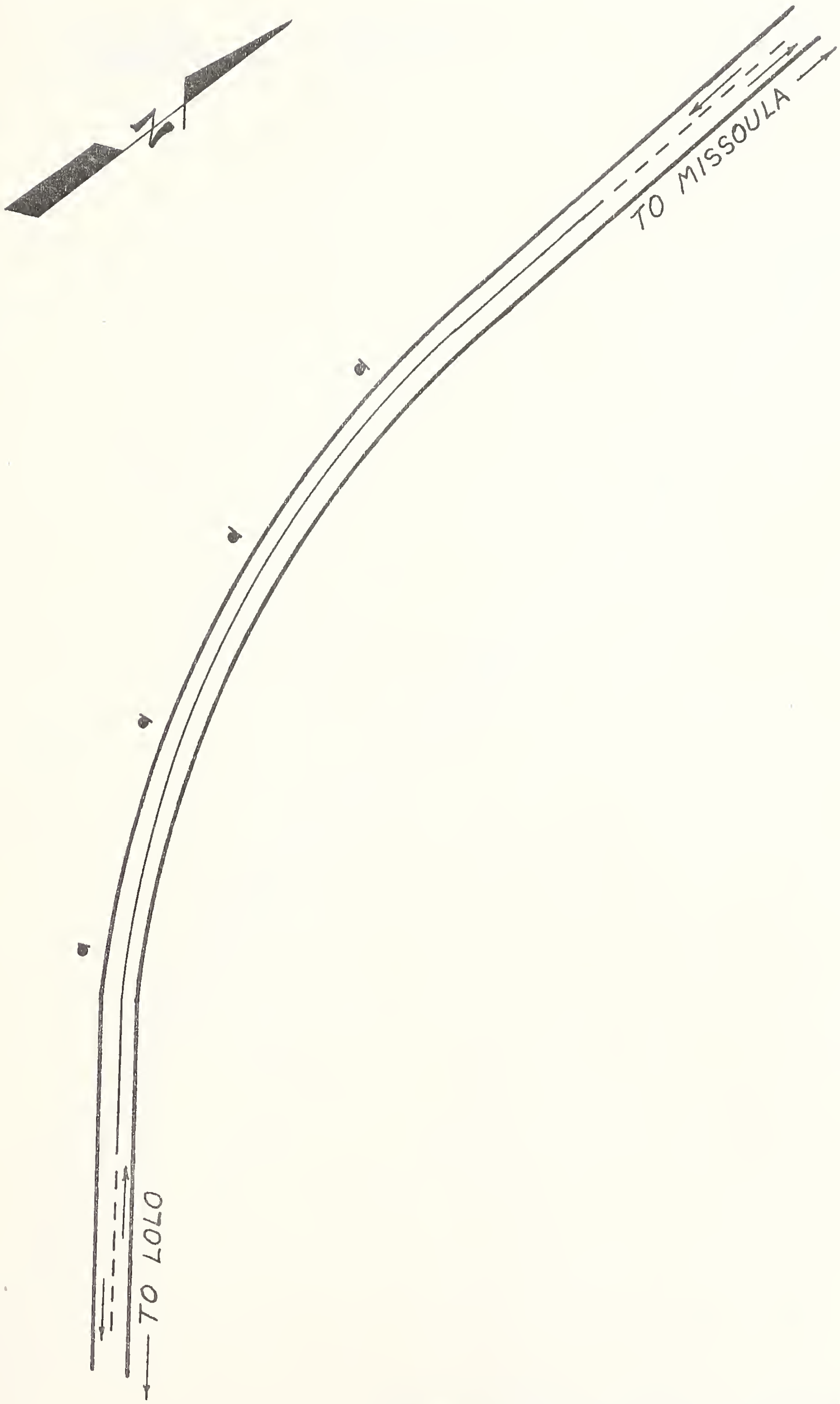
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
MONTANA 200(FAP6) PLAINS — PARADISE

MILE MARKER
FROM : 77.6
TO : 78.5

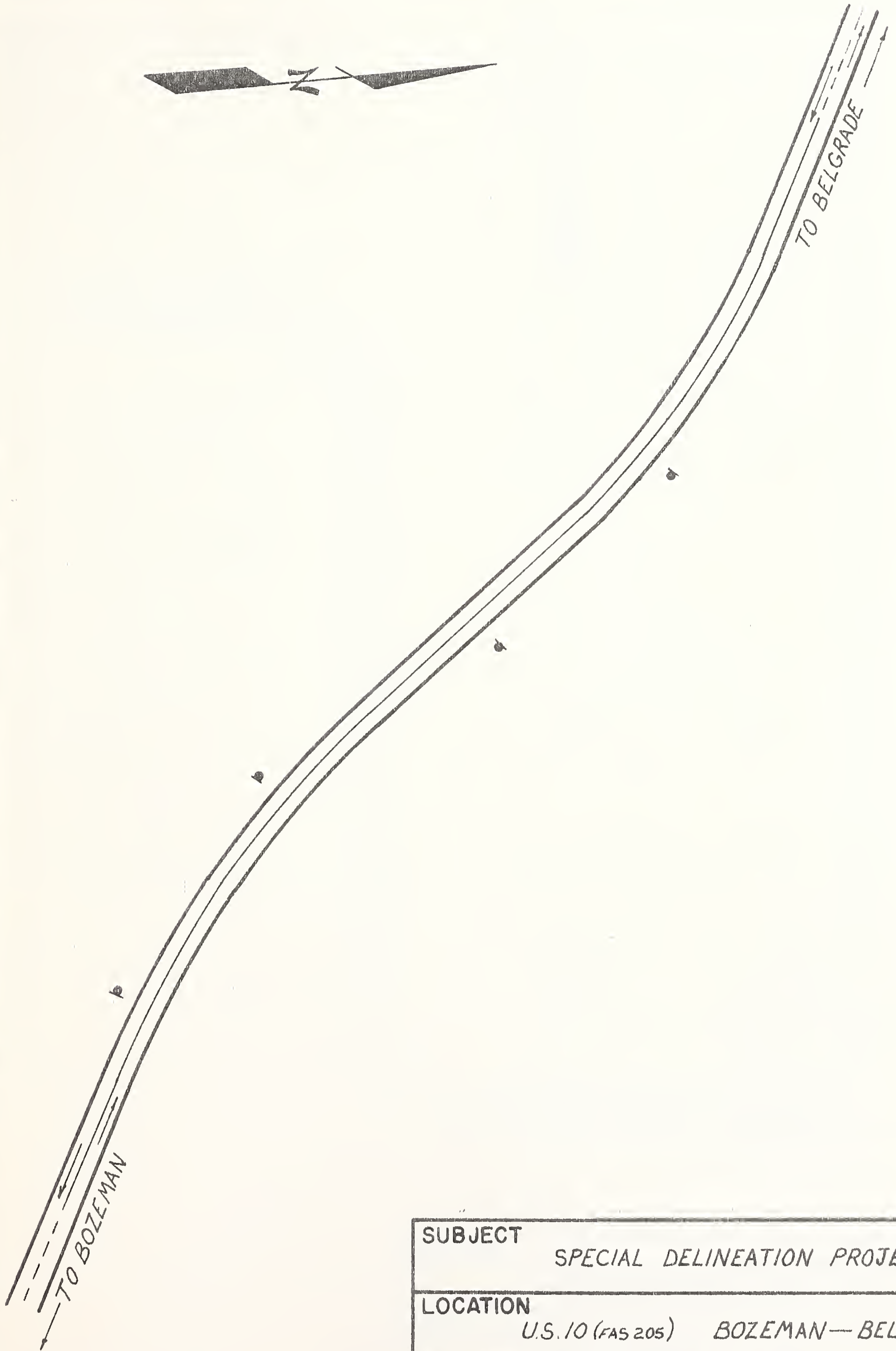
SIGN TYPE
IV



SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 93 (FAP 7) MISSOULA — LOLO

MILE MARKER **FROM** : 85.2 **TO** : 86.7	**SIGN TYPE** IV

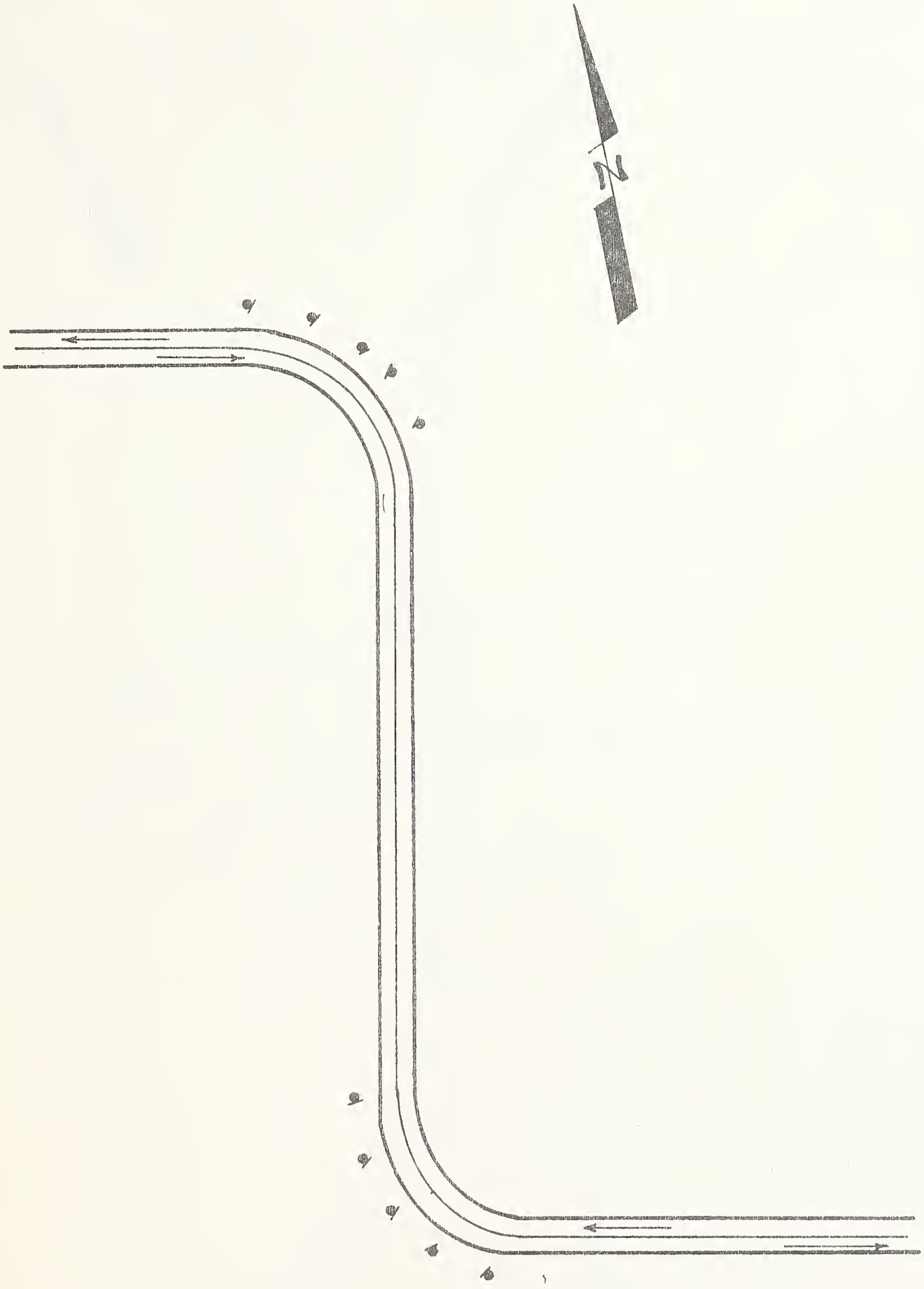


SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 10 (FAS 205) BOZEMAN — BELGRADE

MILE MARKER
FROM : 22.0
TO : 23.0

SIGN TYPE
IV



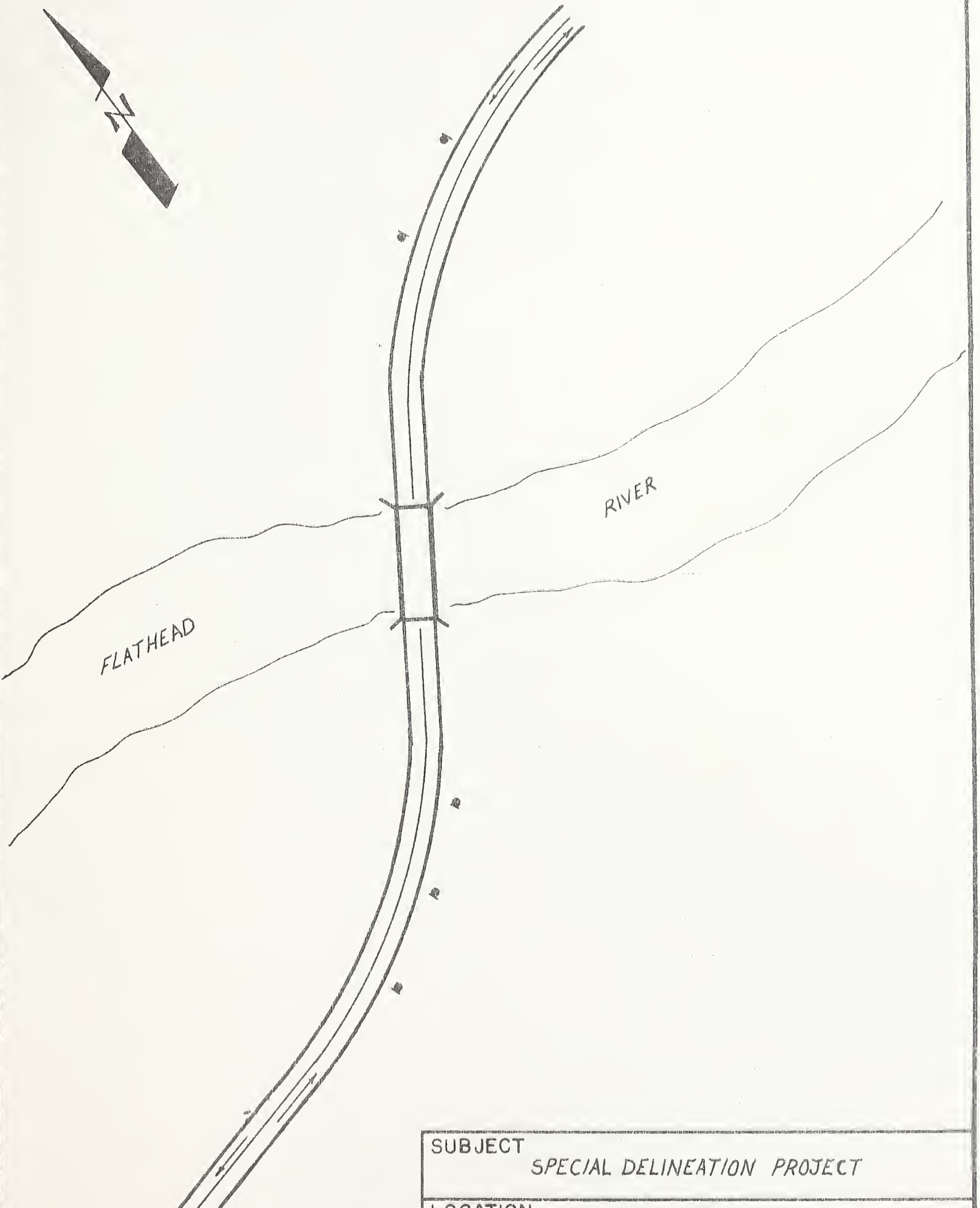
NO SCALE

SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
MONTANA 82 (FAP 82) BIGFORK-SOMERS

MILE MARKER
FROM : 4.7
TO : 5.5

SIGN TYPE IV



SUBJECT
SPECIAL DELINEATION PROJECT

LOCATION
U.S. 2 (FAP1) COLUMBIA HEIGHTS

MILE MARKER
FROM : 141.9
TO : 142.3

SIGN TYPE IV